THE

INDIAN FORESTER;

A QUARTERLY MAGAZINE

OF

FORESTRY.

EDITED BY

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VOLUME VIII.

[*July* 1882 *to December* 1882.]

Calcutta:

PUBLISHED BY THE CALCUTTA CENTRAL PRESS CO., LD.,

5, COUNCIL HOUSE STREET.

1882.

X 143

CALCUTTA:

PRINTED AND PUBLISHED BY A. ACTON, AT THE CALCUTTA CENTRAL PRESS,

5, COUNCIL HOUSE STREET.

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THE

INDIAN FORESTER

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SECRETARIA BRARY

The Cape Forests.

REPORT OF THE SUPERINTENDENT OF WOODS AND FORESTS, M. LE COMTE VASSELOT DE REGNE.

PART I.—*Description and Condition, from a Forester's point of view, of the country visited.* 1882.

KNYSNA DISTRICT.

Route followed.

IN pursuance of the instructions of the Honourable the Commissioner of Crown Lands and Public Works, dated the 20th of April 1881, I embarked for Mossel Bay on the 5th of May last.

Starting on this journey, accompanied by Captain Harison, Conservator of Forests at the Knysna, I made an examination, from a Forester's point of view, following the route which had been pointed out to me, passing through George, the Knysna, Tzitzikama, Humansdorp, Port Elizabeth, Alexandria, Graham's Town, King William's Town, Pirie, Stutterheim, Queen's Town, Katberg, Kat river (or Stockenström), Graaff-Reinet, and Beaufort West.

Points for examination and report.

According to ministerial instructions, the points which I was required more specially to examine, and to which I should very carefully direct my attention, were the following :—

(1.) General management of forests;
(2.) Methods of working;
(3.) Conservation;
(4.) Replanting;
(5.) Preservation from fire;
(6) Utilisation of timber; and

generally whatever bears upon the creation, existence, preservation, and multiplication of trees.

Divisions of Mossel Bay and George.

The neighbourhood of Mossel Bay and the country which came under our observation in following the route to George, as well as the southern sides of the mountains which enclose the division on the north, are destitute of trees.

On approaching George, we passed many perennial streams, and noticed some small clusters of trees in the Kloofs forming

the sources of these rivulets. Three of these lots are inaccessible for working, but still form a part of the Crown lands.

Remains of old forest near George.

They are all that remain of an ancient and important Crown forest either sold, burnt, or to a great extent destroyed.

Before arriving at George, near to Blanco, there is to be seen a portion of Crown forest known as Keur Kloof, in extent about ten morgen, which was burnt in 1869. It is now covered with keur trees (*Virgilia capensis*, Lom.)

Keur Kloof forest.

Beyond Blanco, and proceeding eastwards, the south sides of the mountain contain trees, at first in small patches in the Kloofs, but afterwards in considerable and dense masses with scarcely any interruption.

Rainfall in George and Mossel Bay divisions.

In this region the amount of rainfall and moisture is greater than in the division of Mossel Bay.*

At George trees grow vigorously: there are to be seen in the town fine specimens of the stone, maritime and Aleppo pines.

Trees in town of George.

On the journey from George to the Knysna, along the postal route, there is, at a distance of half a mile, the Crown forest of Groenkops Bosch, 1,692 morgen in extent. About 900 morgen only of these are stocked with timber. As this forest contains chiefly trees too young for felling, it is very properly, according to the system in vogue, closed to working.

Groenkops Bosch forest, at present closed.

Further on stands the private forest of Mr. Bennett, which extends from Kayman's river to the other side of Silver river, with an area of about 250 morgen which comprises part of a lot of ground of about 2,000 morgen which, we were informed, had been sold for £2,000.

Bennett's forest.

Proceeding further, we leave on the right side, and to the south, a portion of Olifant's Hoek, which originally comprised 1,298 morgen. Two hundred of these have been utilized for immigrant locations. Ten hundred and ninety-eight still remain the property of the Crown. Of this extent about 700 morgen are clad with timber. Half of this forest comprises, in its irregular and diverse kinds of timber, a remarkable quantity of workable trees.† The remainder was burnt in 1869. About one-sixth of the surface destroyed by fire is clad with keur trees, already furnishing a supply of spars.

Olifant's Hoek forest.

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* In the Report of the Meteorological Commission for 1879, pp. 23 and 65, it is stated that at Mossel Bay there were 101 days of rain, giving 14·81 inches; at George 147 days of rain, giving 36·44 inches.

† A tree is *workable* when it has reached its maximum of growth or of utility.

It would be very expedient to replant the spots from which these trees have disappeared. The soil is almost everywhere fit for the growth of stink-wood.

Replanting of above recommended.

This timber is much sought after on all sides, and the region of its production is extremely limited.

The postal road then passes south of the forest of Woodville, and continues for some two hundred yards in this direction.

Woodville forest.

This forest is partially wooded to an extent of 802 morgen. It contains some trees of very considerable dimensions, but the greater part of them are not workable. It would not be possible, without injury to the forest, to remove the old trunks* (when granting licenses for this purpose) except with a proviso for previously marking the trees, and looking well after the workmen who cut them down.

The portion not at present timbered is generally of a stony soil, and pending a further and more careful examination, it seems, at first sight, to be capable of being advantageously stocked with pines.

The neighbouring lot, known as the Diep river, is of a total extent of 1,373 morgen, of which 1,000 morgen are scantily wooded.

Diep river woodlands.

The Commission of Inquiry into Crown forests considered it practicable to place three families of immigrants within the boundaries of this lot, and recommended the establishment of a village of wood-cutters on the left bank of the Diep river.

A little further on is situated the allotment of Hooge Kraal Bosch, containing 1,023 morgen, 90 square roods, of which nearly the whole extent is timbered.

Hooge Kraal Bosch forest.

There exists a riparian dispute with the owner as to the southern boundary of this adjoining piece of land.

Particulars of riparian dispute *re* Hooge Kraal.

The allotments adjoining Wolve Eiland, and those which border upon the rivers Karratara and Homtini in the Knysna division, raise an important question of proprietorship.

The title vesting the property of Hooge Kraal, for instance near the river Homtini, describes the eastern limit of this farm thus:—"The river *as shown by diagram*." The plan, however, represents a straight line at some distance from the tortuous course of the river. This leads to the belief that, in accordance with the grantor's intention, we are to understand by the term "river," not the centre of the bed of the water-channel alone, but also the sides of the basin at the bottom of which the river is shut in.

* Old trees useless for felling.

This view seems confirmed by conditions in certain titles of lands including forest, which, in granting the ground, provided for the reservation of the timber.

Government reservations of slopes to rivers recommended.

In the public interest, in fact, the Government should remain proprietor of these slopes. It is the only means of keeping them clad with trees—a condition indispensable to the maintenance of the soil upon the rock beneath. The owners naturally claim by virtue of their title, without taking the diagram into consideration, that their farms stretch as far as the bed of the river. The officers of the Government, on their part, hold that the boundary ought to be the straight line shown on the diagram to which the title refers, and they enforce this condition on the ground.

Prompt settlement of above questions necessary.

It will be necessary for all parties that this question should be promptly decided.

Summary of extent of forest lots in George division, and remarks thereon.

Summing up the foregoing remarks, there are in the George division six Crown land lots containing timber. The total extent of these six lots is 7,918 morgen. Of these about 4,410 morgen are timbered, and 3,508 are not. About 508 morgen of the latter could be utilized for the purpose of immigrant locations, or for wood-cutters' villages; the remainder, say 3,000, are in no way fit for the production of timber.

Unsold mountain lots.

It would be proper also to examine if the mountain lots, which have not been sold, and which are absolutely unfit for agriculture, could not be planted with trees.

There are no isolated trees to be seen in the district, nor even along the water-courses, and not a single large enclosure by live fences.

Periodical burnings: evil effects on certain plants and trees.

The periodical burnings, which are the sole attention paid to the larger part of the soil of each farm, render impossible the development of plants of tardy growth, and cause the unceasing diminution, and even the wholesale destruction, of trees which originally adorned the kloofs comprised in these private holdings.

Forests now closed.

The 4,410 morgen of forest lands of this division are at present closed.

Precautions necessary when above are re-opened.

I am of opinion that the working of these forests should not be recommenced before measures are taken to conduct operations in such a manner as to ensure in future the uninterrupted growth of these forests.

Knysna division. Extent of forests.

The division of the Knysna comprises about 28,000 morgen of forest, 25,000 of which are distributed over a large number of Crown land lots already surveyed, the total area being 60,577 morgen. The remainder, situated near the mouth of the Groot river, and in the region comprised between this stream and Blauwkrantz, is estimated, approximately, at 3,000 morgen, and has not yet been surveyed.

Immigrant allotments. Wood-cutting.

In the portions already surveyed, about 14,000 morgen have been judged suitable for the settlement of immigrants, or for the establishment of hamlets for wood-cutters.

Extent fit for forest culture only.

There remain 21,577 morgen exclusively fit for forest culture.

Inaccessible forest lots.

Of the 25,000 morgen of forest land, at least 5,000 morgen are inaccessible, either for want of a road by which to reach them, or because they are situate on the sides of declivities too steep to render it prudent to work them.

Reasons for trees on mountain sides.

The presence of trees is indispensable to the maintenance of the soil on the mountain sides, and their removal would occasion more or less considerable land-slips.

Extent of forest lots available for working.

Ten thousand morgen at least are available for working, and at many places all that which could have been utilized under present conditions is not now available.

Species of trees found in the forests, with their distribution.

The species of trees which compose these forests are generally distributed as follows, in the district of the Conservator of the Knysna (comprising the divisions of Knysna, George, and Humansdorp):—

(1.) Yellow-wood	20	per cent.
(2.) Iron-wood	20	,,
(3.) Keur-wood	12	,,
(4.) Stink-wood	8	,,
(5.) Assegai	8	,,
(6.) Witte Els	4	,,
(7.) Essenhout	4	,,
(8.) Saffraan	4	,,
Vliers, White Pear, Boukenwood, Hard Pear, Red Els, Keur, Chestnut, Kamassi, Paardepis, &c. } about ...	20	,,

Determination of qualities, &c., of above woods.

The mechanical properties of these woods, such as resistance to tension, compression, flexion, twisting, closeness of grain, have to be separately determined in each case.

Proper times and seasons for felling.

Experience shows that they resist perfectly decomposition by decay and puncture by insects, provided they are felled when mature, and in the proper season, when the sap has ceased to rise; that is to say, from the time of fructification until that at which the sap rises in order to form the flowering buds for the following year. These periods do not all occur at the same time with all the species, as in Europe, but they come in succession in such a way that the forest is never in a state of repose.

The time of felling varies with the kind of tree, and for each description, according to the atmospheric conditions of the year and the district in which the trees grow.

Details of past periods of felling.

For instance, the periods during which felling was practicable in the Knysna district, during 1879 and 1880, were as follows :—

Stink-wood	1879. February to the end of June. 1880. March to the end of July.
Upright Yellow-wood	Do. do.
Boukenhout	Do. do.
White Pear	1879. November to February. 1880. December to March.
Saffraan	Do. do.
Iron-wood	1879. June to September. 1880. July to October.
Witte Els	May to September.
Essen-wood	June to October.
Assegai-wood	1879. July to October. 1880. August to November.
Outeniqua Yellow-wood	1870. November to February. 1880. September to end of February.
Red Els	September to January.
Vliers	October to February.
Kersenhout	November to April.
Wittehout	May to October.
Hard Pear	1879 December to April. 1880. November to March.

Results of felling out of season.

Trees cut whilst the sap is rising do not produce lasting wood, and when used for public works are damaging to the interests of the country.

Even when such wood becomes an article of trade, to say nothing of the wrong done to the persons who use it, the country suffers in reputation on account of the rapid decay of such wood casting discredit upon a Colonial product, and tending to create a preference for foreign timber, the latter being, however, inferior to native woods, provided the trees of this country are cut at the proper time.

It is impossible, therefore, to take too many precautions for ensuring the felling of the trees at the proper season.

Regulations for felling trees (Government Notice No. 361 of 1875), Licenses, &c.

The felling of trees is prescribed by Regulations (Government Notice No. 361 of 1875), in which wise provision is made to secure the best method in every respect. By the terms of these Regulations the Crown forests are open to persons provided with licenses to cut the different kinds of timber, during the season considered suitable by the forest rangers in charge, and at none other.

Mode of proceeding by licenses.

The price of the licenses and the kind and measurement of the wood composing the load which the license gives the right to cut, are clearly stated, and the manner of proceeding is, as nearly as possible, as follows :—

For instance, a person requires stink-wood, and procures a license ; for one load of 60 cubic feet he pays 30*s.* (thirty shillings).

Duties of ranger in regard to licenses.

He presents this license to the ranger charged with the custody of that part of the forest named in the license. The ranger registers and countersigns the license, and then returns it to the owner, who has, thereupon, the privilege of felling the timber specified in the license at the spot pointed out by the ranger. The wood when felled is inspected, measured and marked by the ranger before its removal. It is inspected a second time at the place where the wood is stacked for sale, and after that, the owner disposes of it as he thinks fit.

Contracts with Government, mode of execution.

On the other hand, when the Government requires a considerable supply of wood, for example, several thousand sleepers or telegraph poles, it makes an agreement with a contractor, and the latter executes the order in the portion or ward of the Crown forest which is pointed out to him, whence he transports the timber to its destination, and delivers it according to the price agreed upon.

Needs of original settlers.

The first settlers in a country have imperious and immediate wants. In the first place they must have wood.

Necessity for repurchasing in Europe certain forest rights.

In European forests many rights of usage have been conceded at the time when they then covered a large territory on which it was necessary to locate settlers. These rights became afterwards the source of so much trouble and caused such enormous loss to the State, that it was found necessary to repurchase them, no matter at how great a sacrifice of public money.

Action of original settlers in taking wood gratis from forests.

At the Cape, in the early days of its colonization, people took from the forests merely the wood necessary for dwellings, tools, fences, wagons, &c.,

Later settlers compelled to pay for wood taken from forests.

without troubling themselves about the future. A little later, those who took wood from the public forests were compelled at once to pay its value into the public treasury.

This was well enough at the time, and it was only just in fact that such a payment should contribute towards the funds, by means of which the Government carried on the public service, and that it should lighten, although but in a small degree, the charges imposed upon the community in order to make up the budget. Afterwards the Government made a fresh effort to infuse method into these matters, and hence the Regulations of 1875, which have brought about a great improvement.

Improvements considered.

I shall now consider whether it is possible and opportune to improve upon this system.

In the olden times, if a man wished to build himself a house, he went to the forest as to an inexhaustible store from which he could be supplied gratuitously, where he looked around for a tree of a species, shape, and size suitable for his purpose, standing in a locality whence there would be little difficulty in transporting it. He felled it without troubling himself to ascertain whether it was still in active growth or had arrived at maturity, or whether he should clear the spot if a neighbouring tree of more advanced growth was stretching its branches over the space lately occupied by the tree he had just felled, and thus rendered impossible the development of any saplings. Thus, without taking any precaution to avoid injuring, crushing, or cutting the surrounding trees which, doubtless, rather interfered with the removal of the other tree, but which, though still starting into growth, would, in their turn, if properly cared for, become trees, the selected tree would be cut away at such a height from the soil that a portion of the trunk was wasted and the stump would yield no fresh shoots under favourable conditions. In selecting the tree the settler considered only the length of the timber wanted, and if the tree could yield more workable wood than he required, the remainder would be abandoned, wasted, and left on the spot, together with the head stump and branches.

Original mode of felling and its neglect of necessary precautions.

The presence of such debris on the soil would probably result in preventing any young plant from developing itself in that spot.

The wood in process of decay would become a haunt of insects and a factor in rendering the blaze fiercer in case of fire.

In fine, there is nothing rarer than to see young and healthy trees, of valuable kinds, in localities where timber has been felled. Brushwood, creepers, and twining plants overrun the ground

Disastrous results of the foregoing.

and smother the few young and greatly-injured saplings, which, under such circumstances, can become nothing but useless and stunted trees.

In the second stage the settler is compelled to pay *something* to the Government in compensation for the wood which he has removed, but even then he leaves no less disorder in the forest after his departure.

Regulations of 1875 insure payment for wood felled.

By the Regulations issued in 1875, the Government is completely protected as concerns the recovery of the price for wood felled in the forest.

Information desired by the Government on conservation and felling, &c.

The Government is now desirous of knowing whether the Colonial forests should continue to be treated as if they were, as far as relates to the needs of a progressive community, in reality inexhaustible; and of ascertaining what can be done to improve the mode of felling trees.

Improper present mode of felling.

The general idea which prevails in respect of the felling of wood in the forest is even now that which originally arose from the necessity for satisfying the wants of the immediate moment.

Wasteful mode of felling.

When any one desires a load of timber, for wagon-building for instance, he procures a license which specifies exactly the quantity, kind, and price of the wood he is authorised to cut. At the spot pointed out to him in the forest, he selects the tree most suitable to his requirements. He does not choose such and such a one, because it is too large, and because its transport and sale would not be so easily effected as those of a tree of smaller dimensions; nor another tree, although full-grown, because it has some defect; nor a third, because its removal would be a little more troublesome.

In fine, having obtained a license for a load of wagon-wood, for instance, he of course takes that which will suit his purpose best for the construction of a wagon.

The valuable wood in each tree is exactly measured; the license-holder pays his license money, and the spots where the trees have been cut are reduced to the condition I have just described.

Consequent disappearance of valuable timber.

When a forest lot has been thus denuded of its timber, it is closed, and left to nature's kindly offices to repair the disorder in which the place has been left. But in addition to this, as the forest district of Knysna, where the best timber of the Colony is to be found, still contains stink-wood, yellow-wood, and assegai-wood, the license-holders, having the choice, prefer taking these, particularly the stink-wood, rejecting the iron-wood and several other kinds of trees, which, though very useful, belong to an inferior class. Thus, when a forest section

is closed, it is because it has been deprived of its most valuable products, although it is furnished with workable trees, which have been passed over, either because they are too large, or because they are of a species of wood which, although frequently quite as good as that imported, is yet not quite so easy to work as that of neighbouring trees, which can be selected; and this goes on to the detriment of the forest. The old trunks encumber the ground and impede the growth of the best kinds of trees. The latter thus become still rarer, and will soon disappear from the districts where they are felled now, unless measures are taken to prevent such a deplorable consequence.*

Impending extermination of stink-wood.

There formerly existed in Europe a system somewhat analogous to this method, namely, the "Jardinage," which consisted in clearing away, here and there, the oldest trees, those decaying, diseased, or withered, and those of mature growth, required for the purposes of trade or for local consumption. As regards the future of the forests, this system is far preferable to the licensing plan, since it clears the soil at least of all mature trees, and thus provides space for those not full grown.

Comparison between "Jardinage" and the Colonial "License" system.

There are, however, certain disadvantages attendant upon this method†:—

Disadvantages of "Jardinage."

"The result of this mode of operation is that the forest presents to view at every point, trees of every age, mixed indiscriminately, from the young sapling to the old tree, and that the trees which attain the greatest bulk and height interfere with those placed immediately under their shade, and impede their growth; thus the latter, not having sufficient room, stretch out in branches and nearly always become knotted, and do not attain their natural height.

"The most feeble trees, stopped in their growth by those which overtop them, contract seeds of disease when this condition of overcrowding is continued; they nearly always languish, seldom arriving at a healthy maturity, and often they die.

"This 'jardinage' by extending the felling of trees over very large areas, renders its supervision difficult, and considerably increases waste in both felling and clearing. The greatest objection, however, which is consequent

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* Stink-wood is now found only in the district—very limited in proportion to the extent of the Colony, bounded by Mossel Bay, the Outeniqua Mountains, Tzitzikama river, and the sea: although Dr. Pappe, in speaking of this species, says that it "grows in the principal forests throughout a great portion of the Colony." (*Silva Capensis*, 1862, p. 32.)

† *Cours elementaire des Bois, par M M. Lorentz et Parade*, a work translated into English for the Government of India, (G. Huriot) (*Courrier Francais*, 5th August, 1865.)

upon this method is, that it does not enable the forests to yield, within a given period, any products but those of a nature very inferior, in regard to both quantity and quality, to those obtained by the natural method of propagation by seeds and thinning out.*

"In fact, in cultivated forests (jardinées), we see trees of every kind restricted in their development for a time of greater or less duration, and often, even to the close of their existence.

"In regular woodlands† on the contrary the growth is encouraged from its commencement, and stimulated up to the period of maturity, by periodical fellings undertaken with this very object. Now it is evident that, of two forests, that which will supply the most material in a given time is that in which the generality of trees has the strongest and most sustained growth, other circumstances being equal.

"With regard to the quality of the trees, the facility which they have in cultivated (jardinées) forests to extend their branches, renders them inferior for constructive and splitting purposes to those which had grown in a wild state; and it is to be observed as well that the considerable waste caused by felling and clearing in such a forest, multiplies faulty trees such as are seldom met with in regular woodlands."

Probable beneficial results of application of "Jardinage" to the Knysna forests.

I think that if the treatment to which the forests of the Knysna are at present subjected were changed for that of a cultivation (jardinage), judiciously applied, their production of valuable timber would be more than doubled in a short time; and, if they were continuously treated in a rational manner, this production would doubtless double itself again; that is to say, it would be four times greater than it is at present.

Measures necessary for at once relieving the forests.

Precautions when felling.

However this may be, it is urgently necessary, by either one method or the other, to relieve the soil of full-grown trees, of perishing timber, and of trees belonging to species of second-rate quality, which occupy the ground unprofitably. In the second place, it is none the less essential, during the operation of felling, to clear the soil of debris and the young plants from the creepers and brushwood which smother them.

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* "The method of natural renewal and thinning out consists of working the forests in such manner as will insure their natural and perfect re-stocking, by encouraging as much as possible their growth from their early youth up to the period of their felling."

† "A woodland is called regular when it exhibits in all directions a uniform and complete stock of trees, of ages suitably graduated, and when it contains within itself all the elements necessary for ensuring its natural reproduction."

The ways and means of doing this, which appear to me preferable, are set forth in the chapter in which I have grouped the recommendations in order to give shape to these measures as a whole, they being in the true nature of a careful organization.

Stink-wood, demand for and remarks upon the species.

The wood most inquired for is stink-wood (*Oreodaphne bullata*); it grows rapidly, but is very sensitive in certain respects. Its young shoots are so tender that the least contact with branches injures and kills them. It has as much need of air, light, and space about the head as of the zephyrs at its foot.

Stink-wood disappearing under present "licensing" system.

This species, however, would probably disappear from our forests if they continued to be worked under the licensing system, and if the young seedlings are depended upon as a means of replacing trees which have been cut down. But it possesses a singular property and one peculiar to itself.

Stink-wood, singular faculty of.

When a tree of this kind has been cut, not only does its stump send out shoots, but these again throw down roots, which descend the old trunk in such a way that, although the latter may decay, the original tree is replaced by one, two, or three branches which develop into veritable trees with roots to them.

Stink-wood, bad mode of felling and results on suckers.

Owing to the fatal custom of cutting trees at least three feet above the surface of the ground, these new shoots, resting on branches unable to find the requisite support in the original trunk, have not sufficient stability when the old trunk is rotten, and are thrown down by the wind before they attain a size sufficient to furnish timber.

By virtue of the faculty above described, in the districts which have never been worked, and where the want of light close to the soil has prevented the survival of the young plants, there are found old stumps of stink-wood perished through age, still standing upright, and encircled with a bundle of suckers sprung from their trunks and enrooted in the parent stump. It is possible, however, that these shoots from the stump attain neither the age nor the size of trees springing from seed.

When a plant of stink-wood has had the good fortune to spring up in a clearing,* and the rare luck of being neither too much injured by the fall of the neighbouring trees nor strangled by climbing plants, its growth is rapid, and everything tends to prove that a tree of this kind must have air and light from its very birth.

* A little place destitute of trees.

Stink-wood, scarcity of seed.

The seed of stink-wood is scarce and nearly always worm-eaten.

"The African Oak."

This tree has been styled by Mr. Barrow the African oak (*Chêne Africain*), which he has also likened, on account of its qualities, to the most valuable species of Europe. The oak in the east of France, and in several countries where it forms large forests, yields acorns in abundance every twelve years, but they are difficult to preserve.

Stink-wood timber, value of.

Stink-wood is worth at the Knysna from 4*s.* to 5*s.* per cubic foot. Planks of 20 running feet, one foot wide, by three to four inches thick, are worth from 20*s.* to 25*s.* each, and are sold at £7 10*s.* in the division of Stockenström.

Stink-wood now extinct in Stockenström division.

Stink-wood is not found in the forests of the latter region, although Dr. Pappe, in his *Silva Capensis*, states that it is found "in the primeval forests throughout a great portion of the Colony." Many localities appear to us suitable for its growth. Perhaps there is none of it, and it may never have appeared at all, in that district.

Reason for its disappearance.

Stink-wood, assegai, and witte els generally together.

But, on the other hand, the treatment which the forests have received from time immemorial in this respect would have been sufficient to cause its complete disappearance. It is generally found in company with the assegai-wood, or with the *witte els*, in the forests where it grows.

Stink-wood, possible re-production by cuttings; experiments in progress.

The property which the branches have of forming roots has led me to think that perhaps stink-wood could reproduce itself by cuttings, like the poplar. If this were so, the reproduction of this kind of timber would be abundantly assured. I have recommended experiments to be made with this object.

Yellow-wood.

The tree most widely spread, and that which attains the largest dimensions in the division of the Knysna, is the yellow-wood.

"The African Pine."

If stink-wood is the oak of this country, we may say that yellow-wood is the pine. It appears but little in the habit of sprouting from the stump, but its reproduction from seed seems quite as general and easy as that of stink-wood is difficult and rare. Thus, in nearly all open spaces are to be seen saplings of yellow-wood, of all ages and dimensions, growing in the place of the felled trees.

Easy of reproduction.

Conditions favourable to its reproduction.

When these saplings have not suffered for any length of time, nor languished under the cover of large trees* nor have been too much injured by the removal of their predecessors (yellow-wood, having in only a small degree the property of throwing out shoots, appears to be unable to endure with impunity the severance of its limbs), nor are too much overshadowed by the branches of neighbouring trees, nor too closely entwined by climbing creepers, they often reach a size which places them beyond danger, and become timber-bearing trees. Otherwise they grow without sensibly increasing in bulk, becoming hard and compact, and fit for excellent spars or telegraph poles; but then they never become timber trees.

Yellow-wood, value of.

Larger trees should be selected.

Yellow-wood of middling dimensions is sought for in logs for carpenters' purposes, and is worth about 2*s.* 6*d.* per cubic foot at the Knysna. The largest trees would give excellent timber, but they are passed by on account of the trouble which would be necessary in order to transport them to the place of sale.

Why iron-wood, though plentiful, is little used.

It is the same with iron-wood. This wood† considered suitable for ship-building, and of which axles, poles, and tools are made, remains almost untouched in the forests of the Knysna, while there are imported into the Colony considerable quantities of wood intended for purposes for which iron-wood could be employed.

Its specific gravity and hardness, which render laborious its transport and its sawing by hand, explain this anomaly.

When means of transport improve, iron-wood should become much in demand.

It is to be hoped that when the Colony is provided with better roads for transport iron-wood will be sought for with an eagerness proportioned to its qualities.

Wanton waste of wood, caused by clearing the road through "Sourflat."

At present a road is being constructed passing along the district of Sourflat. The workmen have certainly cut much more timber than was necessary for the formation of the road.

The trees felled represent a very considerable value, to a great extent lost, because at the time of the actual cutting down there were no convenient means of removing them. The men cut off the best pieces in short lengths, which are quite

* A plant is said to be under "cover" of a tree when it is so situated that a portion of the crest or branches of the tree is placed vertically over it.

† According to a report by Sir John Coode to the Crown Agents, under date of the 21st of April 1877, *the result of the trials* (after immersion with regard to sample "iron-wood") *may be considered "as fairly satisfactory."*

unserviceable, in order to throw them aside more easily, and the remainder is wasted on the spot.

How the clearing should have been done, with profit to Government.

If the workmen had limited their operations in the first instance to cutting the trees growing upon the roadway, or at the spots whence earth had been removed; or if they had even considered it necessary to afterwards clear away the timber from the sides of the roadway, considerable profit could have been derived from the wood, because there would have been room made for getting it away, so that even if the extent planted had not been further diminished, the Government would not have been deprived of the commercial value of material now wasted. But probably the workmen considered this too troublesome, and that the removal was necessary in order to prevent injury to the road by the proximity of overshadowing trees.

Road works: benefit of trees as consolidators of soil, &c.

It should have been borne in mind, also, that the trees standing on the sloping ground to the north would have done their part in contributing to the solidity of the embankments, and have been a protection to spans of oxen, and a means of security for loads and travellers.

In other countries, far from felling timber in those parts which command a line of road, haste is made to plant the embankments.

In this way also the trees stop the rubbish which the streams from the higher ground carry down with them, and also give security against the landslips always to be dreaded in newly-made embankments.

This line of road does not appear to have enhanced the value of the timber of the forest to such an extent as one would have expected, considering how much has been spent upon it.

Homtini road, remarks on construction of.

Timber is a product at once cumbersome and heavy, and the declivities are such, at certain points, as to render it difficult for heavy loads to be easily moved. Further, the crossing of the river Homtini is accomplished by means of a causeway and not by a bridge. In winter, at the time of floods, there are delays and difficulties in crossing, which increase the expenses of transport, and the inhabitants of the neighbouring division of George will, it is to be feared, still prefer importation by way of Mossel Bay, and other sources of supply to which they are accustomed.

The Main Road.

There is, moreover, in course of construction in this division, a route which will cross the Tzitzikama. It will give access to districts hitherto inaccessible.

Common woods of the Knysna forests.

I will not at present refer to the common kinds of wood in the district of the Knysna, beyond those which I have previously described. Not because they are without value—far from it—but either because these trees are in demand and their production is so easy that no precautions are taken with regard to them; or because they form so unimportant a part in the general mass of timber that they cannot seriously affect the future of the forests. What I have said of the principal kinds seems to me to render the actual position sufficiently clear to allow conclusions to be drawn from what I shall presently formulate.

Sleepers: Fox and Dunn's contract.

There are now two contracts in force for the supply of sleepers to be prepared in the division of the Knysna. One contractor, Mr. Dunn, undertakes to deliver 500,000 sleepers in five years, or at the rate of 100,000 per annum.

The place of felling has been selected in the district known as lots W and Y, which have never yet been open to the public. This spot appears very well chosen. The stock of trees comprises much yellow-wood, and but few trees of very large dimensions. The soil is firm and furnished with a young growth,* sufficiently mature. Here certainly there is a very favourable opportunity to encourage a young growth, the hope of the forest.

Mode of encouraging growth of young trees.

With this object we must uncover them by taking out all the mature trees which overtop them, but it is expedient to leave a certain number of trees of less age in a forward state of growth at convenient distances, which, without prejudicially covering the young growth,† shall yet cast upon them a salutary shade, properly mitigating the violence of the gusts of wind; and these will become timber-bearing trees when the natural plantation, which it is necessary to develop, can do without their protection. The young plants having the sun shining on their tops, and the trunks in the soil kept fresh by the thick foliage, will thrive under such favourable conditions, if assisted by the others. Every sapling, in order to thrive, requires a certain space in the ground, as much for extending its roots as it does in the air for spreading its branches; and according to the growth of a plant, the space which it occupies becomes necessarily greater.

"Cover" and "Shadow."

* *Seedlings*—A union of numbers of sprigs of seed from the ground.
Sprig from seed—A young tree which has sprung directly from a seed.

† The "cover" must not be confounded with the "shadow." The term *cover* means exercising an influence on the spot of ground which the top and branches immediately cover; it is constant in its injury to vegetation, by enfeebling the effects of light and rain, and by impeding the formation of dew,

All the plants composing the mass cannot, therefore, have sufficient space when each has arrived at twice its original size. Hence the absolute necessity of thinning out as trees increase in number and size. In such a case the young trees struggle with each other to obtain the space which is indispensable for a due share of light and air. In this struggle the weakest plants, deprived of this space, overtopped and pushed aside, will, in a very short time, in the same way as the smaller branches of others, wither and decay; and it is thus that from year to year the number of stalks diminishes, and those which survive, being more elevated and stronger, throw off their lower branches and produce stems themselves of greater length.

Thinning out, necessity for.

In the early age of the forest, this condition of things, far from presenting difficulties, offers great advantages; the young saplings afford each other mutual support against those overtopping them, and assist reciprocally each other's upward growth.

Thinning out unnecessary in early stage of growth of forests.

Subsequently the struggle increases, since those stems which are overtopped, although deprived of the influence of the light, take a longer time to succumb because they are stronger.*

At this juncture some of the sprigs are thinned out from the weakest, the sickly, and the mutilated, choosing among those which, although strong, are too numerous for a limited surface, and thus giving to the vigorous plants, which remain, the space necessary for their free development. This operation should be repeated a second and third time, whenever it may be requisite. Finally here, as well as in all countries where this plan has been adopted, I am confident we shall obtain a production of timber beyond comparison, as regards quality and quantity, with that which the soil at present furnishes.

Thinning out, proper times for.

Anticipated result of.

These explanations, then, of the manner in which it would be desirable to treat the forests, have been suggested by an examination of the portion to be worked for the furnishing of the before-mentioned supply of 500,000 sleepers during the next five years.

Another contract of the same nature is in operation in the division of the Knysna, but is applicable to a considerably less quantity. Mr. Jones has to deliver 25,000 sleepers. This supply will be taken from a district of the main forest near Plettenberg Bay.

Sleepers; Mr. Jones' contract.

* The "shadow," on the contrary, exercises its influence over a certain extent according to the different positions of the sun during the day. It is almost always *favourable* to the growth of trees, inasmuch as it tends to preserve a freshness of the soil and plants, without depriving the latter of the beneficial action of air and light (*Parade; Culture des Bois.*)

Felling licenses for 1880—details.

Licenses for the extraction of timber, delivered in 1880, have been issued for the following quantities, *viz.* :—

Kinds of Timber.	Loads.	Cubic Feet.
Stink-wood	499	29,940
Yellow-wood	88	8,800
Witte Els	7	560
Wagon-wood	289	28,900
		68,200

Stink-wood most in demand.

From this it will be seen that stink-wood is five or six times more sought after than yellow-wood, and almost twice as much as the mixed woods which constitute loads of wagon-wood.

Wood-cutters.

Besides the wood-cutters, who have their working places about the forests, there are at the Knysna two steam saw mills in full work.

Steam Saw Mills, reduction in cost of sawing.

The cost of sawing by this means is from 20 to 25 per cent. less than by hand labour.

Colonial woods, reasons why so little is sold.

The reasons why so little Colonial wood is sold, are these :—

(1.) On account of the scarcity of stink-wood.

(2.) On account of the difficulties of the extraction and transport of the timber, considering the absence of roads in the forest and their insufficiency *beyond*.

Where and how disposed of.

The products are shipped at the Knysna, or at Plettenberg Bay for all the ports in the Colony: by land they are sent to the division of Oudtshoorn, the valley of Lang-kloof, and the neighbouring districts.

Knysna forests: value of produce in 1880.

The produce of every species taken from the forests of the Knysna in 1880 represented a value of £1,253.

Immigrant allotments.

Under the provisions of Act No. 33 of 1879, immigrant families are now being settled in the division of the Knysna upon allotments of Crown lands considered fit for agriculture.

Anticipated beneficial results of immigrant settlements.

The presence of a number of industrious men in the forest districts will doubtless produce a healthy competition, and the immigrants may, if they desire, obtain as wood-cutters abundant means and opportunities of becoming prosperous.

The firewood industry.

This European population will always find at hand the necessary firewood, and, as it increases, it will furnish in the future a certain outlet for products, which are now lying without value on the soil of the forests.

In proceeding to allot the ground, we should carefully reserve every mountain-side which commands a water-course, also on the bank of each stream a strip of land of sufficient breadth.

Reservations on immigrant allotments.

The wandering of cattle over these hill-sides contributes to their denudation, and it is desirable to maintain a wooded condition in these parts.

Cattle not to wander about mountain slopes.

We have no accurate statistics with regard to the relative quantity of moisture with which this division is favoured. It is believed that the locality of greatest rainfall occurs between Blauwkrantz and the Storm river, and that with regard to both spots the mean quantity of rain is constantly diminishing both on the side of George on the west, and Humansdorp on the east.

Rainfall.

Diminishing of above.

If this is the case, it would be sensibly in proportion to the wooded areas in the different localities of this region.

Reason for decrease of rainfall.

Trials of plantations in the division of the Knysna have just been commenced.

Experimental plantations.

To the north of the village, at a distance of about three miles, Captain Harison, the Conservator, has enclosed by means of spars a hollow of about ten morgen open to the south, from whence a small stream escapes. This ground presents mountain-slopes in all directions. The soil appears good, judging by the vigour of the plants which grow there, and a better spot could not have been chosen for beginning the work of tree-planting. On the right of the stream in the lowest part an extent of from five to six square roods has been roughly turned up and sown by drills with seeds of the stone-pine, which has formed a very good seed-bed. In another part of the ground young oaks have been taken from a neighbouring property, as well as young stone-pines from the cultivated ground. The soil has been prepared to receive the plants by simply removing the grass, and digging the ground in patches of a foot square and distant about three feet from each other. The oaks have generally thriven, but not so the stone-pines. It would be better to sow the seeds in boxes, or, more simply and economically still, to start the seeds *in situ*.

I think there is reason to continue these experiments, and to find out by trial the most valuable kinds of Colonial wood.

Above should be continued; and reason for so doing.

The success, so far as concerns the ultimate wooding of this ground, is certain, unless it is set fire to.

Ultimate success certain.

In the division of George, the Knysna, and Humansdorp the space cultivated with cereals is very small: the remainder comprises waste land on which cattle are depastured, and the grass is renewed by setting fire to it periodically. By following this plan the growth of trees on these properties is impossible, so that absolutely none are seen in the country. The proprietor is quite content if he can save a few about his dwelling. From these useless pastures the fire spreads to the woody kloofs surrounding the farms, each time burning a belt of forest of a greater or less breadth, until the timber has been completely destroyed. This can hardly be otherwise, as things are now.

Cereals, space devoted to.

Effects of grass-firing.

Consequent disappearance of timber.

Occasionally fire originates in the forest itself, consumes the underwood, and chars the bark of the trees which wither very soon afterwards. If this timber were immediately felled it would lose nothing of its value, but those who take out licenses do not generally select it; thus, it decays on the spot, and, as a material, is absolutely lost. Generally the keur grows abundantly where these fires have occurred, taking the place of the burnt timber; until even this disappears in its turn when the forest is finally denuded, to an extent equal to that over which the fire has spread. Captain Harison has not allowed the question of these fires to remain without inquiry, and has made the following observations:—

Forest fires sometimes spontaneous.

Charred timber should be sold.

Ultimate destruction of burnt portions of forest.

Observations of Capt. Harison on forest fires.

(1.) They rarely commence in the forest.

(2.) Those which originate in the forest are not so dangerous as fires which proceed from a more general conflagration of the neighbouring parts.

(3.) In winter, when the ground is moist, the fire does not penetrate the forest.

From these facts he has concluded that by burning in winter the grass near the forests, and in thus keeping clear their borders, greater numbers of these disasters would be avoided.

Conclusions drawn by Capt. Harison, and measures taken by him to prevent forest fires.

This has been done in his division, and since the practice was adopted there has been no large destruction to deplore.

Results of such measures.

This is an excellent arrangement. In perfecting this practice by others, which will be indicated further on, I think that in a great measure these disasters will be avoided, and we shall succeed in remedying in a prompt, economical, and efficacious manner the bad consequences which could not have been foreseen.

Division of Humansdorp.

Extent of Crown forests.

The division of Humansdorp, comprised in the same forest district, contains about 18,000 morgen of Crown forests.

Inaccessible portion.

The portion situate between Blauwkrantz and the Storm river is inaccessible to wagons, and has never been surveyed.

Mode of estimating the area of the forests.

The area of the forests which are found there has been roughly estimated by squaring their perimeter, so far as could be done at a rapid inspection.

The contents of the forest are similar to those in the Knysna. Stink-wood is fairly plentiful in certain localities, but there remain, so to speak, but few more fellable trees of the kind in the forests where it has been possible to cut them.

Stink-wood fairly plentiful.

Stink-wood saplings; the only spot where they appear to thrive.

Between Storm river and Captain Harison's house it appears to be found in the conditions most favourable for its production, and there only have I seen saplings of 5, 10, 15 and 20 years old which promise to become trees in their turn.

How above saplings are being injured.

Here again it is to be deplored that they should be injured by their old neighbours, the iron-wood and the witte els, (excessively widespread at their heads), which, under the existing license system, would occupy for ever the greater portion of the soil of these valuable forests.

Finest site for production of stink-wood.

This is the finest field for the production of stink-wood which can be found in the whole of the Colony.

The Government is still the owner of a great portion of the forest land in this division.

Government reservations to be made when these lands are sold.

When the Government shall judge the time to have arrived for selling these lands, it will be necessary to reserve the hills, steep slopes, and sufficient spaces for the production of stink-wood.

Small holdings, propriety of.

It would be desirable also, instead of continuing to create such large lots, of which a proprietor cannot, at most, work more than one-fiftieth of the total area (the remainder being simply burnt as a means of culture), to endeavour to institute small holdings.

Above would support a larger population.

The possessors of these small domains should cultivate them entirely, and thus a larger population would arise in this district. An alienation by means of very small lots would enable us to attain this object, and would fulfil the wishes and needs of many people, and secure a considerable gain to the public revenue.

Humansdorp forests, value and details, &c, of produce in 1880.

The production of the forests of this division, in the year 1880, amounted to £467. The licenses issued for timber were as follows :—

Kind of Timber.	Loads.	Cubic Feet.
Stink-wood	330	19,800
Yellow-wood	40	4,000
Witte Hout	7	100
Wagon-wood	94	9,400
		33,300

Stink-wood and yellow-wood most in demand.

Here also there have been felled five times as much stink-wood as of the yellow-wood, and twice as much stink-wood as of the mixed wood for wagons.

Possible yield or capability.

In order to understand exactly the material existing in the district of the Knysna, and that which could be disposed of without exceeding the limit of production (possibilité),* it would be necessary—

Measures for ascertaining above.

(1.) To make an inventory of existing trees.

(2.) To ascertain the average age at which each species arrives at maturity.

These two measures are indispensable.

Let us take a district under average circumstances, in which no wood has yet been cut. The trees are counted, the cubical contents are measured, and supposing a total of 100,000 cubic feet is found, and it is known that the trees are fellable, say, when they are 100 years old, for example, then—

Since this ground has produced 100,000 cubic feet in 100 years, its average yield has therefore been 1,000 cubic feet per annum. If, then, 1,000 cubic feet are felled every year, and if the cutting is done in such a way as not to restrict the growth of the trees, there will be found the same quantity to cut every year. Therefore, 1,000 cubic feet is the capability of production of the forest.

If the work is done in such a way as to facilitate the growth

* By *possibilité* is meant the proportion of the material which can be drawn annually from a forest, under the condition of maintaining a constant production, as far as possible—a result which we express by the term of a sustained production. (*Parade, Culture des Bois*).

Bearing of proper and improper felling upon the annual yield of a forest.

of trees, there will be eventually a greater number of trees to fell, and the capability should then reach 1,200, 1,500 or 2,000 cubic feet, instead of what is produced in its natural state. If, on the contrary, the felling hinders the development of trees, the capability will decrease to 900, 800, or 700 cubic feet, and then the forest will be ruined. Periodical examination would be necessary in order to ascertain if the system adopted is good.

Periodical inspections necessary.

In districts where timber has already been felled, the operation would be a little more complicated and the problem rather longer in course of demonstration, but it could be easily arrived at. This is not indispensable here, for we already see clearly that at least the two elements above pointed out should be kept in view, *viz.*, an existing content, and the age at which the trees should be cut. There should, without doubt, be an enumeration of trees, but this will take time, and we must consider it as of the first importance to gain, as soon as possible, a knowledge of the resources of the forests of the Colony.

Knowledge of resources of the forests of primary importance.

We have gathered information from men accustomed to frequent the forests, and have corroborated their opinions by making calculations upon a small extent of twenty square yards, when such area appeared to us to represent the average extent of a plantation.

Information on above; how obtained.

Captain Harison has also very kindly caused this to be done by rangers under his orders, who readily assisted with zeal and good will.

From these data we roughly estimate the yield of utilisable timber of every kind to be about 500 cubic feet per morgen, or say 25,000,000 cubic feet.*

Knysna forests: Total estimated yield and value of products.

Of this total, the proportion of stink-wood is not at present more than four per cent., or approximately 1,000,000 cubic feet, and it is almost entirely situated in districts which have never yet been worked; but it is easy to understand that in making a clean sweep there will be nothing for a long time to come, if indeed such a proceeding does not result in the complete disappearance of the forests.

Threatened extermination of stink-wood and of the forests.

This would be analogous to the proceedings of a grazier, who should take it into his head one day to kill or sell all his

* It appears from my researches that the total surface of the forests of the district of the Knysna is in round numbers about 50,000 morgen.

The extent of these forests has been shown in the return presented to Parliament in 1878, in reply to questions relating to Colonial timber, and estimated at 240 square miles, say 72,500 morgen; but it has doubtless been included in the total of portions sold, burnt, and absolutely inaccessible.

cattle, *viz.*, oxen, cows, calves, sheep, horses, asses, mules, colts, and fillies, and who in making a fresh list of his stock should count upon the very young animals which had not attracted his notice, or were too sickly to have tempted him to such a foolish day's work.

Mode of ascertaining when trees reach maturity.

In order to judge of the age at which trees arrive at maturity, and consequently the period required for the production of a corresponding yield, we should, in default of previous observations, have to examine and count the concentric rings of a large number of trees felled under various conditions. Captain Harison has been requested to do this.

Probable age at maturity.

Pending further investigations, from what I have seen, and also from the unanimous opinion of persons of experience whom I have questioned, I have reason to believe that the trees arrive at maturity between 80 and 100 years. If we adopt 100 years as the age for felling, the quantity to be taken annually, that is the actual yield, would be $\frac{1}{100}$ of 25,000,000, or say 250,000 cubic feet; and if we adopt 80 years, then it would be $\frac{1}{80}$ of 25,000,000, or 312,500 cubic feet. If we reckon on 300,000 cubic feet, this is certainly very near the truth, admitting that every forest would be accessible.

Annual yield; mode of arriving at estimate.

But, as we have before remarked, there exists a considerable stock of old trees, of which it would be well to clear the soil. There should be a reserve fit for felling that may be estimated at 5,000,000 cubic feet, and that can be combined with the amount of capability so as to satisfy actual needs.

Trees in reserve.

These valuations are given for the purpose of merely contributing to a general statement.

It must be borne in mind that the yield of every forest must be distinctly and rigorously ascertained, and that the treatment which it should receive must be specially adapted to it.

Yield and treatment.

Products of the Forests of the Forest District of the Knysna in 1880.

Division.	Stinkwood.		Yellow-wood.		Witte Els.		Witte-hout.		Wagon-wood.		Telegraph Poles.	Railway Sleepers.	Poles.	Spars.	Keur Pars	Dry Fire-wood.	Remarks.
	Loads.	Cubic feet.	Loads.	Cubic feet.	Loads.	Cubic feet.	Loads.	Cubic feet.	Loads.	Cubic feet.	Pieces.	Pieces.	Loads.	Loads.	Loads.	Loads.	
George ...	6½	390	...	...	...	...	...	...	1	150	... ..	.....	...	7	99	55	Stink-wood free for Divisional Council of George.
Knysna ...	499	29,940	88	8,800	7	560	...	...	194	19,400	4,168	710	4	21	9	46	
Humansdorp ...	330	19,800	40	4,000	...	...	1	100	94	9,400	.....	.....	...	10	2	...	
	...	50,130	...	12,800	...	560	...	190	...	28,900	.....	.....	...	...	...	101	

(*To be continued.*)

PRODUCE IN CASH.

Total amount of Licenses issued ...	... £1.710	15 0
Estimated Market Value of Timber felled ...	... 15,193	5 0

PRODUCE IN RAW MATERIAL.

1. *Timber*—			*Cubic Feet*	110,152
Stink-wood...	...	...	...	50,130
Yellow-wood ...	...	...	...	12,800
Witte Els ...	...	...	...	560
Witte-hout ...	...	...	...	100
Wagon-wood ...	...	...	...	28,900
Telegraph Poles, Spars, Sleepers, &c.			...	17,662
				110,152
Dry Firewood	...	...	Loads ...	101

Flowering of the Australian Wattle on the Nilgiris.

By D. Brandis.

At this season the Australian wattle on the Nilgiris is covered with flower buds, which are arranged in large panicles at the ends of the branches. These buds take a long time before they open, and only a few trees here and there, or rows of trees, are now in full flower. Most of the trees in flower are small, and all the rest are, and have, since last month, been in bud. When talking over this remarkably slow development of these flowers with Major-General Morgan, he gave me an account of the introduction of this tree on the Nilgiris. General Morgan was for many years in charge of the forests and plantations on these hills, and his remarks on this subject, which I give, as he kindly sent them to me, will, I feel sure, interest the readers of this Journal.

I may add that in the equable climate of these hills, several shrubs and trees seem to have a much longer flowering season than elsewhere; thus the two brambles, which the Nilgiris have in common with the North-West Himalaya (*Rubus flavus* now called *ellipticus*, and *Rubus lasiocarpus*), have been in flower from the middle of March until the middle of June, and *Rubus lasiocarpus* is in flower still, while for instance near Simla a fortnight or three weeks at a certain elevation is the usual time of flowering. *Rhododendron arboreum*, also, which, though called *nilagiricum* by some botanists, is the same species as the common *Rhododendron* of Northern India, continues in flower much longer here than near Simla. It will be understood that I am speaking of trees growing at the same elevation, and otherwise under similar circumstances.

Generally, it may be said that many shrubs and trees have a remarkably long flowering season on the Nilgiris, and I believe that this has long ere this attracted the notice of botanists. A beautiful Myrtaceous shrub, (*Rhodomyrtus tomentosa*) which is common all over the plateau, at elevations above 6,000 feet, has now been in flower ever since March, and on the same shrub will be found the ripe berries (which are eaten) as well as buds and flowers.

Regarding the wattle General Morgan writes as follows:—

"*Notes on Acacia dealbata.*"

"This tree was introduced on the Nilgiris before the year 1845. Colonel Dun, the owner of many houses in Ootacamund, had planted several trees in his compounds probably several years before 1845, but the tree was by no means common, and as late as 1855 was sold at the Government Gardens at two annas a plant. A curious fact regarding the flowering of this tree has been observed:—In 1845, and up to about 1850, the trees flowered in October which corresponded with the Australian flowering time; but about 1860 they were observed to flower

in September; in 1870 they flowered in August; in 1878 in July; and here, this year 1882, they have begun to flower in June, this being the spring month here corresponding with October in Australia. All the trees do not flower so early, because at various times seeds have been imported from Australia, and the produce of these would of course flower at the same time as the parent trees in Australia, until acclimatised here.

"Having watched the flowering of these trees for nearly forty years, there cannot be any doubt in the matter; and it is a curious fact that it should have taken the tree nearly forty years to regain its habit of flowering in the spring. Commencing in October, our autumn, it has gradually worked its way back to summer, and finally to spring; probably it will remain at this point. On arriving in Ootacamund in the flowering time the stranger cannot fail to be struck with the golden appearance of the trees, clothed with blossoms of the purest yellow. Indeed it may be said to be our only conspicuous tree flower; for, though the *Eucalyptus* has its pretty white blossom, the amount of flower is small in comparison with the foliage."

The Forests of Ceylon.

By F. D'A. Vincent.

The general public probably gets its idea of Ceylon by a short stay on the western side of the island, when the steamer touches at Colombo or Galle, or perhaps by the account given of the climate by some relation who forms one of the large and important community of coffee planters, with estates in the centre of the island. The climate and vegetation of the greater part of Ceylon are so different from those of the western coast and of the coffee districts, that I shall first give some idea of the distribution of the rainfall before mentioning the forest vegetation.

The island is exposed to the full force of the south-west and north-east monsoons; and, as these monsoons blow for eight months out of the twelve, it would be natural to suppose that the rainfall is both heavy and equally distributed throughout the year all over the island. This, however, is not the case. The south-west monsoon, breaking generally about the middle of May, passes over two-thirds of the island without more than a passing shower, the principal rainfall of the island being that brought by the north-east monsoon.

If the reader will examine the map of Ceylon he will find in the centre of the southern-half of the island some ranges of hills extending from Kandy southwards to the Moruwa Korle, within 30 miles of the sea. These ranges of hills, about 60 or 70 miles long, form the eastern boundary of the area

affected by the south-west monsoon. All parts lying to the south-west of these hills share more or less in the downpour, whilst the rest of the island only benefits by an occasional shower. The effect of these ranges of hills is most remarkable, and is probably due to their arresting the course of the clouds, and forcing them back towards the sea. In Colombo, which, it will be seen, is south-west of the northern limit of the hills, the average annual rainfall is 87 inches, whilst at Negombo, 18 miles further north, and rather further from the hills, the rainfall is 66 inches. At Chilaw, only 42 miles north of Colombo, and quite out of the influence of any hills or other obstacles to arrest the course of the south-west currents, the rainfall sinks to 48 inches. On the southern coast the same effect is noticeable. At Galle the rainfall is 90 inches, whilst at Hambantota, 70 miles to the east, in the extreme south-east corner of the island, across which the two monsoons sweep, the rainfall is only 20 inches.

The north-east monsoon begins in October, and, lasting till February, distributes its rainfall over the whole of the island, those parts to the north-east of the central mountain ranges naturally receiving most. The hills do not, however, as in the case of the south-west monsoon, protect the lee side of the island, for, at Colombo, and on the western side of the island, the winter rains are often the heaviest and most continuous.

The moist zone, or that affected by both monsoons, is therefore comprised within lines drawn south from Kandy to Matara (about 100 miles), and from Kandy to Colombo (about 60 miles). Within these lines and the sea the rainfall varies from 60 to 230 inches, the average being perhaps about 90 inches.

The rest of the island, or the dry zone, is affected only by the north-east monsoon, the rainfall varying from 60 inches on the eastern coast to 30 and 20 inches at Manaar and Hambantota, the average annual rainfall for the greater part of the area being about 45 inches.

It will, therefore, be seen that the climate of the greater part of Ceylon presents a vast difference from that of the western parts most visited by Europeans. The limits of the moist and dry zones, which have been thus roughly defined, correspond with the limits of two very distinct floras—that of the moist zone is very similar to the flora of the Malayan Peninsula, whilst that of the drier parts of the island resembles in many respects the flora of the Madras mainland.

As regards the forests I may begin by saying that all the forests are evergreen; there are very few deciduous trees, and none of them form any important part of the forest growth.

In the moist zone there are few forests left of any extent, comprising the only parts of the island which are thickly populated. Very large areas of Crown land have been sold for

plantations of coffee, cocoa, tea and other "new products," also for paddy cultivation. Some of the most important forests have also been sold to private persons, who are to work out the timber and sell it in Galle or Colombo.

The forests, which are still the property of the Crown, form only small isolated blocks. In the moist zone the forests do not generally contain much valuable timber. With the exception of Calamander and Nedun (*Pericopsis*) there are no very valuable woods, but with easy water carriage to the coast, all the softer timbers find a ready sale for in-door work, and for coffee cask staves. The principal woods in these forests are:—*Doona zeylanica, Artocarpus nobilis, Caralfia integerrima, Dillenia retusa, Vateria acuminata, Dipterocarpus zeylanicus, Careya arborea, Melia dubia, Pericopsis Mooniana*, several species of *Eugenia, Diospyros quæsita.* The last, Calamander wood, was formerly common in the wet forests with a rainfall of 120 to 150 inches. For cabinet work it is one of the most valuable, but the tree is now almost extinct. Pieces only fit to give planks four inches broad are said to have been sold at the rate of Rs. 400 a ton, and it is difficult now to get even a specimen of this beautiful wood.

Timber work at present is principally directed to the dry zone, where there are still very large areas under forest. In the northern-half of the island, and in a great part of the eastern province, the population is very scattered; villages are very far apart, and probably not more than one hundredth part of the area is cultivated. The rest of the country is more or less covered with evergreen forests, and with tree scrub. The principal forest trees are:—Satinwood *(Chloroxylon Swietenia)*, Ebony *(D. Ebenum* and *D. Melanoxylon)*, Trincomali Wood (*Berrya Ammonilla*), *Mimusops Elengi, M. indica, Alseodaphne semecarpifolia, Vitex altissima, Calophyllum tomentosum.* These form the saleable woods. They are mixed up with a very large proportion of woods which are at present worthless, and almost unsaleable. Most of the forests usually consist of the commoner kinds of wood, with the saleable woods sparingly sprinkled amongst them. The only valuable trees which anywhere form a fair share of the standing stock are Trincomali wood, Satin wood and *Mimusops indica*, and with these it is only in the most favorable situations that any one species forms one-sixth of the standing timber. The following are some of the commoner kinds; some give very fair timber, but there is at present only a demand for the better kinds of wood mentioned above:—

Schleichera trijuga, Strychnos Nux Vomica, Ulmus integrifolia, Acacia leucophlœa, Diospyros Embryopteris, D. ovalifolia, Terminalia Arjuna, Phyllanthus Emblica, and very many others, such as *Stephegyne, Adina, Dysoxylon, Pterocarpus, Cassia.*

A tree forming a very remarkable feature in nearly all

the drier forests is *Hemicyclia sepiaria*. It often forms one-third or even more of the forest, and with its irregular fluted trunk has a very peculiar appearance in large masses. The wood is useless.

The forest soil is generally sandy, poor, and of no great depth, with an underlying rock of gravel, quartz or gneiss. Under the taller trees there is usually a dense scrub, consisting of seedlings of the inferior woods, and of other shrubs, and growing to a height of six feet. With the larger trees over head and the undergrowth, the soil is completely protected from sun and wind, and its natural poverty is less apparent when enriched by thick layers of leaves. Grass is rare in all the forests, and consequently forest fires of any extent are unknown.

Since 1873 the forests have been principally worked by direct Government agency, but previous to that permits to cut timber were issued to traders on payment. With defective supervision, it is scarcely necessary to add that immense harm was done; we now find that the traders succeeded in clearing most of the forests within 25 miles of the seaboard. There is reason to believe that very large thefts of timber took place, but worse than that, the natural reproduction of the better species has been almost at a standstill for the last 30 years. It is difficult to arrive at the real cause of this, but it is possibly due to the fact that the ground was, at the time of the felling, already stocked with seedlings of the commoner kinds of timber. These had been forming the undergrowth for years, only waiting for the opportunity, which the clearing gave, to spring up into vigorous growth.

The forests have, however, a still greater enemy to contend with. Chena or Hen, the Ceylon representative of the Indian Kumri, Jhoom or Toungya, has perhaps done more harm here than in any other part of the east.

A scanty population of Singhalese and Tamils, decimated by disease and famine, and too indolent to undertake paddy or any other form of permanent cultivation, have, for the last fifty years, been engaged in devastating thousands of square miles of the finest forest in the island, to secure one or two crops of millet or Indian corn. The soil after being abandoned becomes covered with a very dense scrub of *Dichrostachys cinerea*, *Phyllanthus Emblica*, *Zizyphus* (four species) *Carissa*, *Dodonæa viscosa*, and other similar species. This scrub grows about 20 feet high in 15 to 25 years, and then remains until the cultivator returns to clear it again. This he avoids doing until he has exhausted all the available areas of rich forest land; and, as he can generally manage, even now, to find some forest which has never been cleared before, it is rare to find old chena land brought into cultivation a second time. Except on the east coast, grass rarely comes up on

chena clearings, so, when seen from a height, the general appearance of the country is most deceptive. Old chena scrub has the appearance of forest, so that looking from one of the many isolated hills of bare gneiss which are so common in the north-east of Ceylon, the ordinary observer would think he had to deal with one vast forest instead of with a sea of chenas, dotted with a few islands, the remains of old forests. Chena cultivation, and the devastations of the traders combined, has only left the remains of what 30 years ago must have been magnificent forests. The work of restoring these remnants and restocking the forests with the better woods will, I fear, take more than double that time to accomplish.

A large portion of the forest produce is exported to India, China and Europe. India takes Trincomali wood for its gun-carriage factories, for the Madras masula boats, &c.; satin and ironwood for building; palmyra for rafters (cut at present in private lands); *Calophyllum tomentosum*, for poon wood masts and spars; and some firewood.

China takes ebony, the blackest wood only, and of this Ceylon has the monopoly. For the best black ebony the price usually is Rs. 120 to Rs. 140 per ton in Colombo. Satin wood and ebony are sent to England, the English market being less particular than the Chinese as to the color of the latter.

Proposals for the Reorganization of the Forest Department in France.

We have received a copy of a pamphlet by M. Grandeau, who is best known to our readers as the Professor of Agriculture at the Forest School of Nancy, on the subject of the French Agricultural Department, with proposals for its reorganization, and especially for the remodelling of the Forest Department, and of the instruction at the several Forest Schools. We need not go into the questions of M. Grandeau's proposals regarding the Agricultural Department in general; it will suffice for our readers if we attempt to give some description of the part of his pamphlet which is most interesting to us.

In his fifth letter, M. Grandeau commences by pointing out that about one-sixth of the area of France is covered with forest belonging—

	Sq. m.
To the State	3,733
„ Municipalities	7,180
„ private estates	24,542
Total ...	35,455

but out of this amount only 2,700 to 3,000 are really fit to produce large timber useful for building purposes. Out of these 35,500 square miles of forest, only 10,800 square miles

are under State management, being the forests belonging to Government and to the Municipalities, and the staff of forest officers which is kept up to manage this area is—

Inspectors General...	... 6
Conservators ...	... 39
Inspectors ...	... 190
Sub-Inspectors ...	... 300
Guards General ...	... 204
Assistant Guards General	... 68
Total	... 807

The Inspectors-General and the Conservators explain themselves. Inspectors correspond to our Divisional, and the others to our range officers, so that the sub-division in France makes the range the lowest unit which is managed by an officer of the superior staff. All above the grade of Guards General are educated at the Nancy Forest School, the Assistant Guards General at those of Villers-Cotterets, Grenoble and Toulouse. After making the above premises, regarding the area and the staff, M. Grandeau puts forward the propositions—(1.) What is this staff worth? (2.) Does it render to the State the services that might be expected from it? (3.) Are there any reforms in its system of first appointment, in its list of grades, and in its functions, which it might be desirable to introduce? And having stated these preliminaries he proceeds to point out how a staff of intelligent and well-educated men, with simple tastes and enthusiasm for their profession, is being employed during, at any rate, a considerable portion of their career, on work which might be just as well done by a lower class of officer. He points out how, so long as they are, as all young officers must be for some years, in the grade of guard-general, their work consists in petty details of an irresponsible character, and in daily occupations which might be just as well done by an assistant who has not undergone the high special training of the Nancy Forest School. Even as sub-inspector, after about ten years service, their work hardly changes; all the change that is noticeable is the small increase to their salaries and a rather larger charge; and indeed, when at last, somewhere about the age of 40 years, they reach the grade of inspector, the change is merely one of degree, and not of work. They still continue to mark trees, to make estimations, check valuations, and do the same work which as sub-inspector or guard-general they formerly made with their inspectors. Eventually, of course, some officers reach the position of conservator, but at an age when they are no longer capable of standing the rough life of forest duty, when they have lost most of their enthusiasm, and when, too, as only too often happens, they find themselves overwhelmed with office business to the exclusion of practical work. Some few reach the post of inspector-general, and then have

large areas of country to visit, and these visits, if not mere road and carriage inspections, have to be made at the expense of considerable physical fatigue and labour, not always easy for a man of 60 to 65 years of age to undergo. So that, in short, in answer to the first and second propositions, it may be said that the French Forest Service consists of an enthusiastic body of well taught forest officers, ready to give their minds and their energies to their work, but tied down and discouraged by years of subordinate duty, with no scope for personal energy or that responsibility which would go far to reconcile them with their small pay, and with the prospect of only at an advanced age finding themselves in a position where initiative is possible. Such is the present condition of the forest officers in France as described by M. Grandeau.

The Professor then proceeds, in his sixth letter, to indicate generally his proposals of reorganization. These are to make the grade of guard-general a subordinate one, filled by students from the smaller schools, and to arrange that the Nancy-trained man shall be at once appointed sub-inspector, the work of which grade of officers should be considerably altered. On leaving Nancy, students could be made probationary sub-inspectors, and would spend three years in learning the details of forest work, and, if possible, in several different classes of forest, as in the Vosges, the Jura, the ordinary plains forests, and the restoration of denuded areas in the Alps.

At the expiry of this period they would become permanent sub-inspectors with the charge of two ranges, one directly, the other through a guard general. The new sub-inspector would correspond directly with the conservator, and have the same powers and authority as the present inspector, who indeed is so called by a misnomer, for he inspects nothing.

To make this change there would be no change in the staff, or necessary increase to the budget, though it would very considerably improve the position of the officers trained at the Nancy Forest School. Instead of the present inspectors, a class of officers, with attributes corresponding to their title, could be created, who would have the inspection only of a certain number of sub-inspectors, and who would have their head-quarters at the same place as the conservator, where for half the year they would form a sort of council for putting together and arranging the elements of forest statistics, while the other half they would be occupied in travelling on inspection. Such a class of inspectors would be most valuable; they would learn to know their forests thoroughly, and would, when the time came, be better prepared to take up their appointment as conservator. Very little change would be required in conservators except that they should be younger men, able to devote more energy and activity to the work than can be at present expected. Nor is there any change proposed in regard to the inspectors-

general, except that they too should be appointed at a younger age, when they are still able to endure the sometimes fatiguing work which their tours require, and should have an inspector attached to them as secretary, who would be able to assist them when on tour, and during the winter season at Paris help in the office in the preparation of forest economic statistics.

At the same time as he makes the proposal we have sketched regarding the reorganization of the staff, M. Grandeau continues in his seventh letter to consider the question of the reorganization of the different forest schools.

His proposals are briefly these : To have two classes of forest schools, *viz.*, the secondary schools and the national forest school.

The secondary schools should be three—at Grenoble or Gap, at Toulouse, and at desBarres corresponding to the regions of the Alps, the Pyrenees, and the east of France. As it is obviously an advantage that guards-general should remain as long as possible at the head of the range to which they are appointed on leaving the school, it will manifestly be useful to recruit them, as far as possible, in the forest regions where their families live, and they should be recruited chiefly either from young men who have satisfied military requirements, and at least reached the rank of non-commissioned officer, or from the sons of guards and brigadiers, who show special aptitude for the work. The limit of age should be thirty years. The teaching staff should not be composed, as at present, of officers having their own work to do as well, but should be specially appointed for that work alone, and the general control of the lectures and the plan of study should be drawn up by the professors of the national school, so as to make its teaching agree with that of the secondary schools. The guards-general turned out by these secondary schools should only be allowed to become sub-inspectors after passing a severe examination at Nancy in all subjects taught at the National Forest School. In regard to the training at the National Forest School at Nancy no great changes are proposed, except to make the course what it was formerly—a three years one—to return to the school its forest, the forest of Haye, lately taken away from it, and to alter the course of studies so as to give the first year a course of fundamental teaching in science and the second and third years the courses of applied science, forestry, working schemes, and the higher teaching in surveying.

The old school for forest guards at des Barres would be abolished so far as the guards are concerned, as M. Grandeau does not consider such a school necessary, and in future he would recommend all guards to be old military non-commissioned officers, who would have thus some 3,000 to 4,000 appointments, including those under the municipalities, thrown open to them. We have now sketched as shortly as possible the outlines of M.

Grandeau's proposals. It remains to be seen if they will be adopted, and we understand that they have been opposed most strongly by many of the old officers of the department, and professors of the Forest School. To us, they seem to be particularly worthy of attention, and we are sure that any scheme that will give better pay and prospects to the ridiculously underpaid forest officers in France ought to be eagerly welcomed in that country.

A trip through Chamba.

HAVING arranged for coolies on the 13th June, it being necessary to give 24 hours' notice to the post master, having also obtained from the State godown some large "kiltas" covered with leather (cost Rs. 3-8 each) for our cooking pots, &c., we made a start for the first stage—Musroond, 12 miles—early in the morning of the 15th. We saw everything off ahead of us, took some cold breakfast in one of the nice little Chamba baskets and went off. The road for about six miles is fairly level, through a pretty country, along the right bank of the Ravi, and is lined on each side, in parts, with fine trees, of which the principal are the "Kharak" (*Celtis australis*), one of 14 feet girth above buttresses, "Dauri" (*Cedrela serrata*), "Piák" (*Alnus nitida*), "Punná" (which we were not able to identify), Bombax, Fig, Melia, "Pakrein" (*Rhus punjabensis*) very like a toon tree, "Dodan" (*Sapindus detergens*), a "Kakkar" (*Pistacia integerrima*) here and there. The hill sides to the east were sparsely covered with olive, some of three feet girth, but stunted, "Mendu" (*Dodonœa viscosa*) and a few "Guina" (*Mallotus*). Of ferns the following varieties were noticed along the road: *Nephrodium molle* and *Lastrea odorata*, *Pteris longifolia* and *cretica*, *Adiantum Capillus-Veneris* and *caudatum*, *Asplenium varians*, *Cheilanthes farinosa*, *Polypodium proliferum*, *Aspidium aculeatum*.

At about six miles from Chamba the road begins to ascend till the village of Pokri (Puker on maps) is reached. This is sometimes used as a halting place, and is well suited for a small march (eight miles), there being a good encamping ground with a bunnia's shop for supplies. From Pokri the road is level for a very short distance, after which there is a very steep and bad bit up to the village of Hammal (Hamat on map) whence the first view of the river Suil is obtained; then there is a gradual rise to the village of Matiara, and thence gradually down to the encamping ground of Musroond.

From Musroond there are several fine views. To the north-east is the grand Randhár range, with a very strange gorge called the Pukrúng "galla," the trees which are growing on the north slope just showing over the edge of the range; the rule of the southern slopes being bare of trees appears to have

no exception in these hills. Any one who never saw the north slopes, were such a thing possible, would go away with the idea that this was a most barren country. To the south of Musroond can be seen the Dalhousie Station, while below, and to the north, flows the Suil river, which joins the Ravi at Kandla not far off. The only 'game' we saw on the road consisted of one black partridge and a long green snake, which latter went off too quickly for us to get his name. So far this is not a country for game, except near Chamba, where there are some "pij" (gural or ban bakri).

The apricots being just now ripe, we indulged in a good "feed" from the trees. As yet we have only seen growing the "Chir" or small kind (*Prunus armeniaca*), though in Chamba we regaled ourselves on the large kind, which is hereabouts distinguished from the other by the name of "Khobani." From what we could gather, this would appear to be a grafted variety.

16*th.*—*To Kalail, ten miles.* Up at half past four, sent everything ahead, took our breakfast with us, and started. The road at once descends with a very steep gradient to the Kared nuddy, a stream which, judging by the smell, is strongly impregnated with sulphur; it is crossed by a wooden bridge not too strongly built. Then begins a very steep ascent through an utterly barren country to about the level of Musroond, and from there the road rises and falls over some six miles of the same sort of country until it finally drops down to the encamping ground of Kalail. There is no village of this name; it would appear to be merely the name of the "ilaka." The encamping ground is situated just above a nice stream, but at the bottom of a valley with steep barren hills on either side, and as it is low down we found it very hot during the day. The stream, which has no name, joins the Suil about half a mile away to the north-east. Owing to the natural barrenness of the southern slopes, and to the fact that most of the northern slopes were cultivated, we had very little to observe. Indeed, as the day was very hot, and we walked all the way, we were only too glad to get on quickly to our tents. I should call this a very stiff march on a hot day as there is a good deal of "up and down" at steep gradients. Just below Musroond, in the fields of the Erwár village, were the finest olive trees we have ever seen—one girthed 40 inches, and another 52 inches, the latter being at least 30 feet high. Near the Karéd nuddi were many fine "Piák" (*Alnus nitida*), the wood of which is said to be of little value. At a small spring above the Karéd nuddi is a pretty little nook, with a beautiful bank of very fine *Adiantum Capillus-Veneris*, some large *Woodwardia radicans*, and large *Pteris longifolia*. Here and there along the roadside were stunted plants of the usual *Asplenium varians*, *Nephrodium molle*, *Lastrea odorata*, &c. During these two marches we

have worn the Chamba Sandals (*chaplis*) and find them quite as easy as boots along a road, but we think a boot far preferable for a climb where there is no road, and certainly when descending, as "chaplis" have the fatal objection that they have no heel to dig into the ground.

17*th*.—From Kalail we left the high road and turned to the east up the Kalail nuddi, to the Chatri forest, which is situated roughly on the northern slopes of the Randhar range, mentioned as being seen from Musroond. Our road was a mere footpath, impassable for ponies, so we had to walk. The distance is said to be six miles. It was a very pleasant walk, except that parts were very steep about one foot in two feet gradient. The first part of the road ran along the edge of the nuddi, which has a good deal of water in it though not fit for floating logs. There were many enormous "Piak" (*Alnus*) growing on its bank, many of them over 12 feet girth. The ferns too were much finer, *Lastrea prolixa* of large size, *Woodwardia* very fine; on the trees *Niphobolus fissus*, *Asplenium varians*, and *Asplenium trichomanes*. I saw here the first *Aspidium falcatum*, very fine. To me, accustomed to Darjeeling where *Woodwardia* is a rarity, it was a wonder and delight to see whole banks covered with it growing most luxuriantly. As we got higher we passed through a mixed forest of "Killar" (*Parrotia Jacquemontiana*), "Dhauri" (*Cedrela serrata*), "Kakkrein," "Kharak," &c., till we came to the region of the oaks, pines, horse-chestnut, poplars, &c. Here I saw my first "Kail" or "Chir" (*P. excelsa*), which seemed to me a much handsomer tree than the *P. longifolia*. The most unpleasant part of the journey was the last half mile to our tents as the path was exceedingly steep, and led through fields and past dirty Guddis' huts. The Guddis are very affable, and generally bring out a lotah with milk, but I usually find it is the precursor of a request for a tree to build either a new house or repair an old one (here trees are given free for building purposes). They all ask for deodar, but we are endeavouring to make them take "Tos" and other kinds. The hill sides are so steep here that we could hardly find space enough for one small tent, and even then the tent pegs were in all sorts of odd corners. It rained in the afternoon so we were unable to go out into the forest.

18*th*.—We went out with the intention of going through the forest to the top of the Randhar peak, but could not manage it, as we found the spur along which we went turned in another direction, so we explored as far as we could go. This is the usual mixed pine forest of deodar, kail, tos and rai, with accompanying oaks, &c., and is a very good one of its kind, there being still many fine trees; of deodar we measured six just as we happened to pass them, and they ran 16, 14, 17, 18, 15 and 18 feet girth, at 6 feet above ground, but they do not grow to a corresponding height. It is a great pity that this forest

cannot be worked for logs; there is no floating stream available, the river Suil being about four miles off in a direct line, but then had there been a floating stream the trees would have been cut long ago by traders under the Chamba State management, as it is only sleepers can be brought out. We hoped to get a shot at a bear or leopard, but though we occasionally saw marks of the latter along the path, we saw nothing else. In one place there were marks of a bear in a hollow stump—even to a black hair or two sticking to the sides. The Guddis said he had been getting into it to eat the decayed wood of the deodar, which, according to them, is his food at this time of the year—rather dry feeding. There do not seem to be many pheasants as we only flushed three or four. Besides the pines the forest vegetation consisted of Oaks, including "Kharen" (*Q. semecarpifolia*), "Brami" (*Taxus baccata*), "Maral" (*Ulnus Wallichiana*), "Killar" (*Parrotia*), which last the Guddis say makes better walking sticks than "rous." This I shall put to the test later on. At the top of the spur we found the "ringal" bamboo, but nearly all had flowered and died; the Guddis say it does so every twelve years. The ferns were few, the kinds being the same as usual, and the only noteworthy one being *Diplazium polypodioides* whose young shoots are eaten here, and called "kisror."

J. C. McDONELL.

(To be continued.)

Forest Work in Hongkong.

WE have received copies of the Annual Reports of the Botanic and Afforestation Department for 1880 and 1881, from which we extract the following which, we are sure, will be read with interest:—

1880.

* * * * * *

Persea Nanmuh, Oliv. From the small tree of this valuable timber tree of Yunnan, which Mr. Watters kindly sent from Ichang, we have procured about half a dozen young plants, by layering. The little tree has succeeded very well in our garden, and if a large stock of it could be obtained it might be a valuable addition to our plantations. I have tried to get seeds or plants from Yunnan, and correspondents have kindly promised their assistance, but as yet nothing has come to hand.

Cytisus proliferus var. ("Tagasaste"). The seedlings (about 50) which were planted on the hills about a year ago grew remarkably well until the hot weather and rains commenced, when, I regret to say, they all perished, proving the unsuitability of the climate for this fodder plant.

Rhagodia hastata (Australian "Salt Bush"). The same may be said of this fodder plant as of the above "Tagasaste," it having grown vigorously until the hot weather and rains set in, when it perished.

Pithecolobium Saman (The "Rain Tree"). Small trees which were carefully planted in prepared ground in 1879 continue to thrive, many of them are six to seven feet high. But those which were planted in

unprepared ground, although nursed by the trees of a young plantation in which they were planted, are only about two feet high.

Manihot Glaziovii (Ceara Scrap Rubber). In good soil a small plant, which I brought from Kew Gardens in 1878, and which was then only about three inches high, has grown to a tree about 15 feet high, and is now seeding freely. It seeded last year also, and from the seeds which were produced we raised several small plants, which were planted on the hills, at about 400 feet altitude, last autumn, but the cold of the past few months killed them down to the ground—the lowest temperature recorded at the gardens, alt. 300 feet, was 46°; but all are now making new shoots from the surface of the ground. The old plant was not affected by the cold.

Liberian Coffee. A few plants of this, which have been in the gardens for four years, do not thrive at all well, although the Arabian coffee grows luxuriantly and fruits abundantly.

Pai-cha wood. The wood used at Ningpo for carving is called by this name. The tree from which the wood is obtained has not yet been identified, but as I have succeeded in obtaining a small plant of what is reputed to be the true one, there is some hope that when it flowers the doubt may be set at rest; judging from the appearance of the plant, without flowers or fruit, it is a species of *Euonymus*.

Macadamia ternifolia (the "Queensland Nut"). In my last report I mentioned that this had flowered for the first time here. Now I am able to state that the flowers were succeeded by a very fair crop of nuts which tasted quite equal in flavour to those produced in Queensland.

* * * * * *

AFFORESTATION.

The following trees were planted during the year:—

Pinus sinensis, two-year old plants	144,948	*Brought forward* ...	210,542
Pinus sinensis, size from 4 ft. to 10 ft. high	862	Ficus retusa (Banian) ...	61
Pinus sinensis, sown *in situ* ..	60,555	" " (") large trees transplanted	16
Aleurites triloba (Candleberry-tree)	24	Pinus canariensis (Canary Island Pine)...	23
Aleurites triloba (Candleberry-tree) sown *in situ* ...	1,900	Cupressus funebris (Funereal Cypress)	26
Eucalyptus spp (Gum-trees) ...	1,537	Syncarpia laurifolia (Turpentine-tree)	14
Cupressus torulosa (Bhotan Cypress)	452	Grevillea robusta (Silky Oak) ...	22
Bamboos	164	Dammara robusta	21
Quercus salicina	50	Stillingia sebifera (Tallow-tree)	25
" Harlandi	50	Albizzia Lebbek	31
		Miscellaneous	234
Carried forward ...	210,542		211,015

Nine years' experience has shown that two-year old seedlings of *Pinus sinensis* cannot be successfully and economically planted in consequence of the roots penetrating the soil to such a distance that balls of soil cannot be kept adhering as perfectly as desirable to the roots. No seeds of any kind were sown in the nurseries during 1879 for a supply of trees which should have been provided for planting during the year under notice, therefore when the Afforestation Department was returned to my charge in the end of the year 1879, I found that there was nothing available for planting except the refuse in the nurseries after the planting of 1879 had been finished, and these remaining trees were, through having been too much crowded, attenuated and very unpromising subjects for planting on the exposed hills, for which sturdy well grown plants should always be prepared. It was, however, advisable to do something with the available trees, therefore the most weak and sickly trees were pulled up and sacrificed, to afford

what benefit could be obtained during the three or four months, which intervened between that time and the tree-planting season, to the trees which were selected for planting. In the face of these drawbacks it was anticipated that, however careful we might be in transplanting, a large percentage of deaths would inevitably ensue—a result which occurred, but not to the extent anticipated; about 20 per cent. only succumbed.

About seven years ago an experiment was made of sowing seeds of *Pinus sinensis in situ*, that is, small places, each about a foot square, were dug and levelled on the hillside, where it was intended trees should grow, and on these sites a few seeds were sown. The trees on the plots of ground thus treated succeeded so well, and finding also that the trees reared by the villagers on Chinese territory and on this island had been thus reared, I was induced to prepare and sow 60,000 sites in the same manner. The seedlings on these sites having given sufficient promise of succeeding, a much larger area, *viz.*, nearly 600 acres, containing about 650,000 sites, was selected for this mode of afforestation during 1881. Although the trees reared *in situ* do not grow so vigorously for the first few years as those reared in and transplanted from nurseries, still the method has much to recommend it. Taking it for granted that the same amount voted for afforestation during this year will be granted annually until the wooding of the island is completed, we shall be able, by sowing *in situ*, to accomplish this desirable object in a quarter of the time of that necessary under the nursery system. When the trees are large enough to fell for firewood, &c, a financial return for the outlay expended upon them can, it is hoped, be obtained by judicious periodical thinning and felling of portions of the plantations.

It is still desirable that nurseries, although on a smaller scale, should be maintained for raising a supply of trees for planting in situations where sowing *in situ* may be impracticable, and also for rearing other than pine trees which demand nursery treatment preparatory to planting, as it will be an object kept steadily in view to experiment with and introduce, where successful, such foreign trees as are suitable for our soil, climate, and exposure, as will relieve the monotonous aspect of too much of any one kind of tree, besides, if possible, introducing others which may be valuable for timber or other economic uses.

As will be seen by the foregoing list several other than pine trees have been planted. I may mention first the *Eucalypti*, of which over 1,500, comprising about a dozen kinds, were planted. Where these were planted amongst three-year planted pines they succeeded fairly well; *Eucalyptus citriodora*, the lemon-scented gum, having grown to, in some instances, 9 feet high in ten months, the largest having a circumference of 3 inches at one foot from the ground. Those planted away from the shelter of other trees have not done so well. The pine trees on the large area planted during 1880 will be about the right size in 1883 to be good nurses for other trees which I would advise being planted amongst them. It would be necessary to begin the preparation of such trees next year. More trees of the lemon-scented gum would have been planted last year, but it was impossible, in consequence of the limited supply in its native country, Queensland, to obtain sufficient seeds.

On the spur of Mount Gough jutting out towards Head Quarter House, above Kennedy Road, the sky-line of the ridge, at the instigation of His Excellency the Governor, was planted. Large bamboos, oaks (*Quercus salicina*, and *Q. Harlandi*), pines, and banyans were used. The effect is very good, and the plantation a marked improvement to the scenery on the upper side of the above named road. There was much trouble in getting the large and weighty trees up the steep hill, but the result obtained is well worth the trouble which was taken.

The nurseries were taken in hand and a large number of pines reared for planting in 1881, besides several other trees, such as *Albizzias*, candleberry tree, tallow tree, oaks, &c., some of which will be planted.

this year, and some next, when they will have become a good size.

Although so much work is being done in tree-planting, the nature of the ground operated on, and its distance from the roads, renders the work hardly appreciable to casual observers. After they have been planted on the hills, the small trees remain hidden by the long grass until about two years afterwards when, just as they overtop the grass, they become plainly visible from a distance, and at the end of the third year they make a very fair show. Those sown *in situ* are about one year longer than the others before they alter the appearance of the landscape. In a year hence the trees which were planted twelve months ago will be visible from the roads; of the trees then visible there will be about 120,000, that is, nearly twice as many as are contained in all the other plantations put together.

Afforestation consists not merely of *planting* trees but of conservation and preservation from wanton and accidental destruction of trees, shrubs, and seeds at present on the ground. The recent authorization of the appointment of Forest Guards, to check the destruction of, and damage to, trees and shrubs by persons and goats will have a most salutary effect. Still, although the damage will be greatly diminished, some offences must necessarily occur, as there will always be some persons in this, as well as other things, to break the law when they can have a chance to do so with impunity. I believe that the cutting of trees is frequently done at night in the vicinity of villages and near the sea-coast—at the latter, probably, by boat people.

The Little Hongkong woods—the most beautiful bits of natural forest vegetation on the island—suffer considerably from the depredations of wood-cutters. The vegetation is in most parts so thick and impenetrable that it is difficult to patrol the woods efficiently. It would be a great aid to their preservation if some walks or narrow tracks could be cut through them, not only for the benefit of the Forest Guards in their work, but also to render the woods accessible to pedestrians and picnic parties, to whom this portion of the island might become a favourite resort if it were made a little more attractive by artificial means. Perhaps something in the way of a Japanese or Chinese "tea garden" might be established there. A new mountain road from the top of the Little Hongkong woods to Wantsai Gap, where it would form a junction with the Wantsai and Aberdeen road, would make the woods accessible and form a pleasant walk from this side of the island, and from the Peak houses.

1881.

Afforestation.

The following is a tabulated return of planting operations during the year:—

Pinus sinensis, one-year old	97,695
„ „ three-year old, 3 to 5 ft. high ...	3,776
„ „ *in situ*	649,587
„ Thunbergii, *in situ*	7,000
Eucalypti	4,347
Stillingia sebifera, (Tallow Tree) *in situ* ...	6,000
Quercus salicina, & Q. Harlandi	2,115
„ Japanese spp.	2,240
Rhus succedanea (Wax Tree) *in situ*	1,800
Melia Azedorach (Pride of India) *in situ* ...	1,110
Bamboos	654
Syncarpia laurifolia	344
Castanea (Chestnut) *in situ*	300
Albizzia Lebbek	319
Carried over ...	777,287

	Brought over	...	...	777,287
Cocos nucifera (Cocoanut)	...	...	...	196
Aleurites triloba (Candleberry Tree)		...	...	180
Ficus retusa ("Banyan")	...	...	...	71
Dammara robusta	...	...	...	61
Aleurites sp ...	...	...	...	26
Miscellaneous ...	...	...	...	93
				777,914

The total number—777,914—of trees planted shows an increase of 566,899 over the previous year's work, *i.e.*, the number has been nearly quadrupled. This year we expect to make an increase of about a quarter of a million over those planted last year, which will make a total for the season of 1882 of over a million additional trees for the Colony.

As will be seen from the above table, many kinds of trees beside the Chinese Pine have been planted. Some of them are put out for experiment; and I have great hopes that they will succeed; but others are of indigenous trees which are certain to do well. A few of them, as the Japanese Wax Tree, the Tallow Tree and the Pride of India, will probably furnish valuable products, as they do in China and Japan, such as wax, vegetable tallow, and timber, besides the great addition of diversity of form and colour which they will make to the beauties of the future sylvan scenery.

Roadside planting outside of the town has been extended on both the Pokfoolum and Shaukiwan Roads. About a mile of the former, and a little less than a mile of the Shaukiwan road, was planted. The trees used were bamboos and "banyans." Many of the former were purchased from Chinese on the mainland. The "banyans" were transplanted from the Botanic Gardens, Bowrington Plantation and other places where they were no longer required. The dimensions of these trees ranged from 7 feet 2 inches down to about 1 foot 6 inches in circumference, at three feet from the ground; in height, after about half the length of the branches had been lopped, from 25 feet, downwards to 10 feet; and their ages were from about 25 years down to 10 years. A few of these trees were much damaged by the large larvæ of a species of *Longicornes*. Many kinds of trees here during the weakened condition of their health, consequent on removal, are very subject to attacks from species of *Longicornes*. The eggs of the *Longicornes* are deposited in the bark, and when they hatch the larvæ subsist by consuming the inner portions of the bark, thus causing much injury to, and sometimes the destruction of, the tree.

By the typhoon of the 14th October 20 trees in the streets and roads were blown down, most of which, however, were replanted in their old positions or conveyed to, and planted in, more suitable sites.

Ten nurseries in Hongkong and Kaulung have been maintained. The trees—small seedlings—in two of these, which are situated at considerable altitudes—900 to 1,100 feet—suffered severely in the October typhoon. Although, for the sake of saving labour in the transport of trees, it would be very desirable to maintain nurseries high up on the hills, in the middle or vicinity of intended planting grounds, the damage done by this typhoon to the seedlings points to the inadvisability of risking quantities of tender seedlings in nurseries in high and exposed positions.

In the beginning of the year, Forest Guards were appointed to protect trees and shrubs from the depredations to which they were constantly subject, and also to control the goat-keepers in regard to the lands used for grazing purposes. For the protection of the young trees it was found necessary to interdict certain lands for grazing purposes and grass cutting, and to allot lands where goats and cattle might be

permitted, and where grass might be cut. The result of the appointments has been very satisfactory. Tree-cutting has been very much checked, and the cutting of large pine trees, which had gone on very much, has been almost entirely stopped, except at Little Hongkong, where there have been two or three instances of a number of good sized trees being felled and carried away. The villagers report that the cutting was done by night by boat people who landed at Deep Water Bay. I have much reason for believing, however, that the villagers themselves are the culprits, and to put a stop to this tree cutting it may be necessary to adopt more stringent measures.

Hill fires have occurred in several places. In the vicinity of the Chinese Cemetery on Mt. Davis the grass was set fire to twice—by worshippers at the Cemetery. I believe in the first instance the fire destroyed about 5,000 healthy trees which had been planted only a few months, and in the second case about 600 trees were burnt.

It is a great pity that the report for 1881 takes no notice of the growth of the *Nan-muh* trees mentioned in that for 1880. The wood of this tree fetches perhaps the highest price of any wood known, sandal not even excepted, in China, where it is the most valued kind for the durable coffins in which all true Chinamen desire to be buried, and for which they pay very large sums.

The growth of the "Rain Tree" is evidently slow in Hongkong compared to India. In Bengal we have seen seedlings reach ten to twelve feet the first year.

It is not extraordinary that the "Pai-cha" wood, so long a puzzle to botanists, should seem to be a species of *Euonymus*. The species of that genus in the hills of the Punjab have a beautiful wood for carvings which may some day find a market.

Regarding the planting work done, too much praise cannot be bestowed on the systematic and successful way in which the Hongkong authorities have set to work.

Village Forests.

In an article on Agriculture in the "Asian" for June 20th it is stated that one of the points to which the Agricultural Department is specially directing its attention is that of the development of a system of village reserves. It is stated that they have already desired the Forest Department (we presume the Inspector-General) to point out what steps can be taken to assist in placing the question of the establishment of these reserves on a proper footing. It seems also that the Provincial Government have been asked to furnish information on the following points:—

(*a.*) What waste lands are at the present time the property of Government, and available for fodder reserves?

(*b.*) What waste lands, in which proprietors or cultivators have grazing or other rights, can be appropriated without serious injury to the neighbouring population?

And the article further goes on to say :—

"And it may perhaps be that orders will also be passed disallowing any private interests to be newly acquired in any part of the waste area without reference to the Agricultural and Forest Departments; and measures will be taken enabling Government to appropriate areas of waste lands within the meaning of the Land Appropriation Act on payment of reasonable compensation."

"The usefulness of such measures becomes still more apparent when we consider the fact that trees are a powerful engine in the production of coolness and moisture, and that their growth throughout a country afflicted with dryness and heat should be promoted. Mr. E. C. Buck, noting on this very point in 1877, with reference to a pamphlet by the late Colonel Corbett on the climate and resources of Upper India, said :—

" 'The reply will be made that we do encourage the preservation and increase of forests, and so far have done our duty. But is it so? No doubt we have been doing a great deal to maintain the woods of the sub-Himalayan regions, and to clothe our mountains with forests of new growth. But the question still remains whether belts of thick wood in the Terai, or luxuriant forests on ranges of the Himalayas, will add moisture to the arid climate of the Doab, or give rain to the famine-stricken plains of Bundelkhand. The effect of an edging of verdure along the mountain boundary of the north upon the climate of the wide-spreading plains of the south is probably so remote as to be inappreciable. A much greater, because a more proximate, influence will be exercised by the increase and encouragement of scattered groves, of lines of trees, and of small plantations throughout the agricultural area of the Provinces, in which direction little has been done except in the adoption of the negative measure of releasing grove lands from the payment of revenue, and by the occasional plantation by Revenue officials of avenues of trees along public roads.

" 'The superstitious reverence of the Indian ryot for trees which his grandfather planted has hitherto saved grove upon grove, but when the price of wood rises, reverence for ancestry falls, and when Railway Companies offer cash for fuel, holy plantations sink before the more sacred rupee. The destruction of wood along the low hills of Bundelkhand for the supply of the Allahabad market proceeded of late years at so rapid a pace as to alarm the local authorities, and to cause the Commissioner of Allahabad to bring the matter to the notice of Government; while, at the other end of the Province, the Collector of Shahjehanpur urged measures to prevent the disappearance of wood for the supply of fuel to the new Oudh and Rohilkhand Railway. Some system is necessary which

will lead to the conservation and increase of plantations or trees, not only in ring fences like forest-covered tracts, but in scattered patches, wherever the nature of the ground permits trees to be planted without interfering with cultivation.'

"Colonel Corbett gave an apt description of diffused arboriculture in the following words:—

" 'Supposing the country to be divided like a chess-board, the squares of, say, a mile each in measurement, the black squares planted with trees and bushes, and the white squares left bare for cultivation, the planted squares would absorb a great amount of the solar heat which fell on them, and the air in the day time above them would not be so hot as that coming in contact with the surface of the bare squares. The cooler air over the planted squares would, by its greater gravity, sink and displace the air over the bare squares as it became heated and expanded. At night the heat absorbed by the planted squares during the day would be given off by radiation, the superincumbent air would be chilled, sink, and spread over the surface of the bare squares, displacing the more heated air which had not been chilled by radiation. The trees on the planted squares would act mechanically in checking and breaking the force of the wind, as a lattice-work breakwater breaks the force of the waves; they would also deflect the wind upwards; it would not sweep over the surface of the bare squares as it does over a plain where there is nothing to check its force, and its drying effects would be lessened. The surface soil of the bare squares would not be so dried and hardened from the action of the wind as the open plain now is: the air would contain more vapour of water evaporated from the trees of the planted squares, and this again would interpose a screen which would lessen the amount of solar heat falling on the surface of the bare squares. The soil of the bare squares not being so dried and hardened could be ploughed and broken up at any season of the year, which now it cannot be, owing to its hardened condition; and when broken up it too would further help to moderate the heat of the hot weather by its increased absorptive and radiative powers.' "

We are very glad to hear that this question of village reserves has some chance of being taken up. The Forest Act recognizes three classes of forests—reserved, village and protected; and hitherto, as far as we are aware, only the first and last categories have been constituted. The large forests, usually in more or less distant localities, where population is scanty and communications bad, have been commonly made into reserves, and will prove in the future admirably situated for fulfilling the object of their reservation—the supply of large timber. Protected forests or their equivalent in reserved forests, such as the second class reserves in the Central Provinces, consist usually of forest lands from which the object of Govern-

ment is to derive such revenue as can be obtained, consistent with managing the property in the most economical way, until such time as the cultivator will come and reclaim the land. Where they exist, these forests serve to a great extent the purpose of village forests, but not entirely, for village forests, if they ever are instituted, must be more strictly managed than protected forests usually are, and must not look to eventual cultivation as their final end. All our actual areas, in many provinces at any rate, are to be found in the outlying districts, while the central and populous districts hardly ever contain any; and yet it is in them that drought and famine chiefly occur, and in them too, since the time when the old forests were destroyed, the custom has usually grown up of burning for their household fuel the cowdung and similar matters whose proper place should be on the fields. To overcome this long-established custom may not be an easy one, and it is usual to hear officers, who should know about such things, declare in an airy way that it is impossible. But we do not think so ourselves: we think that, when by village forests or other means, a supply of fuel as cheap as the cowdung cakes is brought to the doors of the people, they will very soon recognize its value and alter the class of their fuel and their habits accordingly.

When we travel in the hot season by the East Indian Railway northwards, or rather north-west, from Calcutta, we usually find ourselves in the early morning after our departure, just passing the last traces of the Sal forests of the Sonthal Pargánas near Luckieserai. Thence, with very slight exceptions, indeed, scarcely a patch of tree growth, save an occasional mango tope, meets our eyes till we have passed off the East Indian Railway on to the Sind-Punjab line. Everywhere we see the villages and walls plastered with these little cakes bearing the impress of the human hand to which every Anglo-Indian or Anglo-Indian traveller is so accustomed. We see a bare dry plain, over which sweeps unhindered the dust-storm which almost succeeds in stopping our train, and the glare from which is only bearable through the medium of blue glass. Why should not these plains too have their patches of forest, not huge reserves of hundreds of square miles filled with wild animals, and whose forest working rotation is scarcely under 150 years; but, as we have often seen in France, and in England too, *coppice* wood forests which can be worked, on as short a rotation as possible, to yield a large amount of material of the kind which the Indian labourer prefers for fuel, sticks and small pieces which do not require to be cut or split, and at the same time a fair supply of poles for houseposts and implements.

We have not yet in India any very accurate data of the yield of such forests as we describe. Changa-Manga was said to yield (see page 403 of our April No.) 200 cubic feet

per acre per annum, so that if this be taken, one square mile would give 128,000 cubic feet per year. We may consider that each family in the Indian plains ordinarily burns about quarter maund fuel per day, or, say, 100 maunds per year, so that a population of 100 families to the square mile requires 10,000 maunds, or about 20,000 cubic feet. In this way each six square miles of cultivation would require one square mile of woods to keep its supply regular, and provide also for unforeseen demands when such occur.

In many parts of the country there are, as suggested by Mr. Buck, lands which can be transformed into forest without interfering with cultivation. And even in the parts of the country where such do not exist, might it not even be well in the interest of the people to convert a portion of the cultivable area into forest? A small inconvenience might be caused to a few people at the present date, but a lasting benefit to the future population would be secured.

We have in our mind districts where almost all the level land is under cultivation, but in which here and there, denuded of almost every vestige of living growth and of vegetable mould, rise barren rocky hills, burnt over every year and searched by village cattle to the most distant recesses for a few mouthfuls of fodder in the hot season. It would probably not cost a very large sum to Government to obtain either possession or control over these lands, to purchase outright or acquire on perpetual lease, and convert them into green and pleasant-looking hills. It would, of course, not be without some expenditure of money, and especially of labour; but in time, as is happening in Ajmere, the attempt would doubtless be successful, and a great benefit to the country secured, at no cost of disturbance to cultivation. Some difficulty might naturally arise as to the disposal of the grazing, but local circumstances in such cases can alone be considered, and proper arrangements would probably not be difficult to make, while the re-constitution of shade-giving forest would encourage the grass and assist in the supply of a much larger amount of fodder than can now be obtained.

We hope the time is not far distant when the Government of India will settle to devote, for a period of years, the whole amount of the surplus forest revenue, to the acquisition of land and the constitution of village forests in those districts which are most in need of them. In most provinces we have already completed the most important and pressing work—the demarcation of the large timber reserves, and the areas actually available at the present time; and it will now be right that our energies should take a fresh direction, and that we should endeavour to establish village forests, not for the supply of large timber, but of the small timber and fuel required by the peasants of this country.

Notes regarding the Cultivation and Propagation of the Paper Mulberry in Japan.

By T. Tanaka,

Chief of the Agricultural Bureau at Tokio.

The paper mulberry is a deciduous shrub which grows to seven or eight feet high in its natural state. In cultivation it rarely reaches higher than five or six feet, in the form of a bush, because it has to be cut annually. Its leaves are four or five inches long. It can be cropped after four to five years from the time of planting, and then will annually yield a supply of fibre for paper pulp.

It is propagated by layering, division of roots, cuttings, and by sowing, but the last method is slow and not usually practised.

Layering.—In the latter part of March the ground is dug around the plant, light manure is applied, and the young twigs are then layered down in the ground which has been previously dug. They are then covered with earth three inches thick, leaving only the tops of the twigs out of the ground. In the following spring, when small roots grow from the twigs, the layers are cut and planted in prepared ground, on small mounds about 18 inches apart, from which new shoots sprout in about ten days after planting. By September they often have reached a height of three feet.

Propagation by division of the roots.—After the twigs have been cut for pulp, some of the mounds on which grow suitable plants for propagation during the next year, are deeply covered with earth, and in the next spring season new shoots sprout from the hill. They are then taken up and the roots separated and planted in the nursery ground, and after three years they are transplanted to the fixed ground or field, and are fit for cutting after another year.

The method of planting and cultivation.—The young plants may be planted on high ground, on mounds, or in fields, in March or April. In June they must be carefully weeded, the dry weeds being piled around each mound on which the plants are growing, for they make a good manure.

The harvesting of the plants may take place any time during the season when the plants are deciduous (from September to February). The manner in which they are prepared for pulping is the same as for mulberry plants, as usually practised in Japan, and the average amount of the annual harvest of pulp has not yet been ascertained, as it differs considerably in different provinces.

There are eleven or twelve varieties of the plant, besides which there are five varieties of the wild species, which are used for

making paper of inferior quality. The *Broussonetia Kazinoki* and *B. Kaempferi* also belong to the same genus.

[*Note.*—By Dr Brandis' kindness the rooted cuttings of *Broussonetia*, sent from Japan, were sent to us in Darjeeling. As they looked so feeble on arrival we had them planted at once, and we are glad to say that they are sending out good shoots. When better established, they will be moved to the Terai, as the winter frosts in the hills would perhaps kill them.—*Ed.*]

Ripening of Deodar Seed.

By D. Brandis.

I have read with great interest the remarks regarding the time which the cones of deodar require to ripen, by Mr. A. Smythies in the January number, and by Mr. McA. Moir and Mr. Wilmot in the April number of the "Forester."

I may mention at once that when, after publishing the Forest Flora, I returned to India in 1874, and found more opportunities than I had previously had of watching the habits of the deodar, I felt doubts regarding the statement on page 517. I made a note in my copy of the work, and I probably mentioned it to my friends; but other matters occupied my attention, and I never systematically followed up the subject.

The observations now recorded seem to establish it beyond doubt that in the Jaunsar and Bhagirathi forests the cones of the deodar, as a rule, require one year only to ripen, and this is a most important result; but I feel sure that I have seen half-mature cones on the tree in autumn, together with ripe cones, and it is quite possible that there is a certain irregularity in the habits of the tree which requires further research. Continued observations in different parts of the Himalaya, similar to those already published in the "Forester," will doubtless set this important question at rest.

I may add that I have not succeeded in coming to a definite conclusion regarding the habits of some other coniferous trees, and particularly regarding the time which the cones of the Khasia pine require to come to maturity. I had studied the tree many years ago in Burma, and had stated my doubts on the subject on page 508 of the "Flora." I again took up the matter while on the Khasia hills in 1879, and again while on the hills between the Sittang and Salween rivers in 1880, but was not able to satisfy myself on the subject. The "Indian Forester" will, I hope, be the means of clearing up the uncertainty which still exists regarding the habits of some of our coniferous trees in India. The publication of a handbook, like the "Forest Flora," was a sort of first venture, intended to pave the way for future progress. Many of the conclusions recorded in that book were necessarily based upon insufficient data; and, as observations are multiplied and made over a wider range of country, these conclusions will be corrected, and some of them will be thrown overboard. But this is the only way in which progress in a scientific profession can be made.

Eucalyptus, Italian Olive and Carob at the Public Gardens, Lahore.

It is much to be regretted that the species of the various specimens of *Eucalyptus* is not known with certainty; but the Superintendent of the Gardens believes that the names are correctly given to the trees of which the measurements are recorded below:—

	Height.	*Girth at breast height.*
No. 1—*E. rostrata*	... 72′	3′ 6″
„ 2—*E. marginata*	... 75′	4′ 3″
„ 3—*E. saligna*	... 74′	5′ 6″
„ 4—*E. saligna*	... 97′	5′ 11″
„ 5—*E. resinifera*	... 73′	4′ 8″
„ 6—*E. resinifera*	... 73′	5′ 2″

These trees are all said to be about 17 or 18 years old. Most of them have thrown out large branches beginning at 15 feet or 20 feet from the ground, and several have suffered a good deal from the wind. The tops of Nos. 2, 3 and 4 show signs of dying off, and the Superintendent thinks that they have all ceased to make rapid growth. He has kindly consented to measure these and a number of other specimens of *Eucalyptus* annually, and to keep a record which will no doubt prove of great interest.

There is an Italian olive which was imported about 25 years ago, and which is now a fine bushy tree of over 30 feet in length. It flowered freely in March 1881, but bore no fruit, and in February of this year there was no sign of its flowering. Mr. Spooner has grafted a number of shoots from this tree on to plants of the indigenous olive raised from seed, and he hopes to obtain fruit from them.

There are several Carob trees of over 30 feet in height, which in February of this year bore large quantities of pods of six or seven inches in length.

F. B.

Bamboo for Paper Stock.

TO THE EDITOR OF THE "INDIAN FORESTER."

Sir,—I trust in fairness you can allow me a little space to show your readers and Mr. Routledge that his attack on me in your April number was unjust, and due to his want of a "little" of the knowledge that he warns me is a dangerous thing.

With a little *more* knowledge I am sure he will see his mistakes, so with your permission I will ignore the personalities, and say as little as I can of them while giving all the information I can that may interest others.

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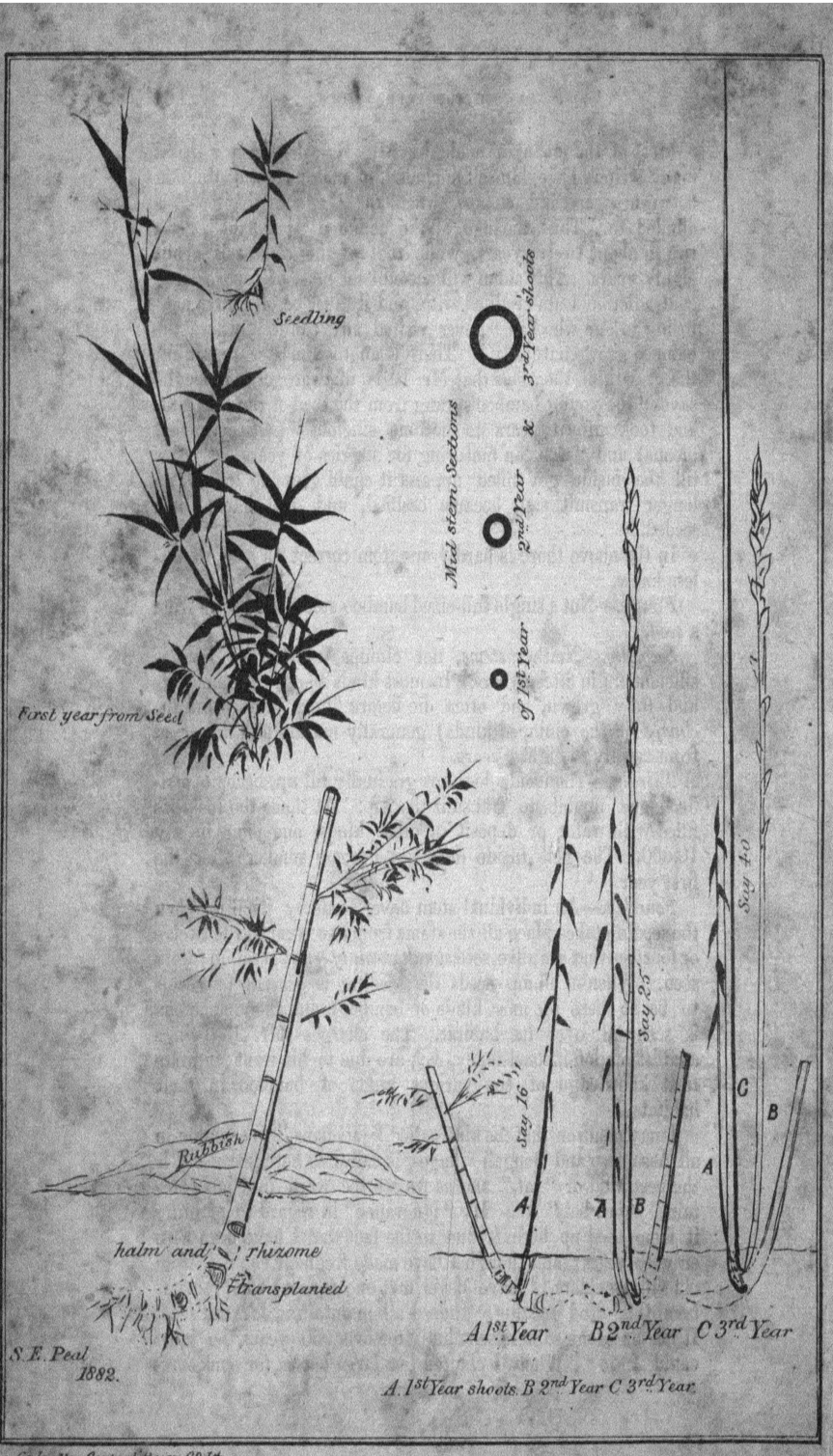

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Most of the mistakes made by Mr. R. arise from a habit many writers have, himself included, of making no distinction between *stems* and *clumps*, when the "age of bamboo" is alluded to. Thus the age of the common "jati bans" *stems* run to about twelve years, while that of the *clumps* is about eighty years. This alone will account for most of the seeming contradiction I am credited with, and it must be of course confusing to one who has "never visited any country where the bamboo grows naturally." There is another matter regarding the growth of the *stems* that Mr. R. is unaware of. I see he says, "the young bamboo sprang from the seed of the old plant, and took fifteen years to become silicious" (whatever that means) and "went on maturing for a series of years * * till the inside got filled up, and it could grow no longer, no longer transmit sap, became ossified, and died, having first seeded."

In the above there is hardly one item correct as you doubtless know.

Firstly.—Not a single full-sized bamboo stem ever grows from a *seed.*

Secondly.—Neither *stems*, nor clumps, mature or become silicious (?) in fifteen years. In most kinds the *stems* are mature and fully grown, and often die before fifteen years; and the *clumps* (in the clumped kinds) generally mature and flower at from twenty to eighty years.

Thirdly.—The inside does not gradually fill up, become ossified, and unable to transmit the sap. At times the inside is filled with water or deposit of other kinds, one joint in say 10,000. The hole inside does not become smaller after the first year.

Fourthly.—An individual stem never seeds by itself. When the seeding takes place all the stems from one year old to twelve or fourteen that are alive, seed *simultaneously*—an operation rarely seen. When a clump seeds the seeding is *general* (or seems to be so here for most kinds of bamboo), and the phenomena is seen all over its habitat. The charges Mr. R. brings against me, of inconsistency, &c., are due to his want of practical knowledge of the various kinds of bamboo in their habitats.

I may mention that the kind called "jati bans," so common in all Assamese and Bengali villages, is called so here because it is the best kind or "jat," and as we see the word in "jati plantain," "jati bet," &c. My "ignorance" in regard to planting it from seed up here is due to the fact that I have been here only 18 years; and though I have made frequent enquiry from old village elders, I have never met one (so far) who remembers this kind seeding. Indeed all maintain it does *not* seed. It has not done so here seemingly for over 60 years, so what could I do? When I planted two large baries (or enclosures

of bamboo) I perforce had to do what every one else did, and put in the stems and root, and this has been described before in your magazine I believe. When a bamboo seed falls and germinates, it comes up like a shoot of grass; other shoots coming out from the eyes at the ground during the first year. In the second year fresh and larger shoots rise from near the ground, and in some kinds their whips are thrown up. The seed, never directly and in the one year, gives rise to a so-called "bamboo," or *full grown stem.*

In the third year of most kinds a crop of long stems rises nearly simultaneously, while a good deal of foliage springs around the original shoot and offshoots, from the *eyes* in which these stems arise. In the "jati bans" the first whips of second year may be 16 feet high and an inch thick, nearly solid, and are not called bamboos.

The shoots of the third season may run up 30 feet and be 1½ or 2 inches thick in the stem, which rises *at once* of its permanent size and thickness in stem and walls.

The shoots of the fourth year are often full size, *i.e.*, say, starting in May, they run up 2 inches or 2½ inches thick, to 50 feet by October, the foliage not appearing till the full height is attained (for obvious reasons.)

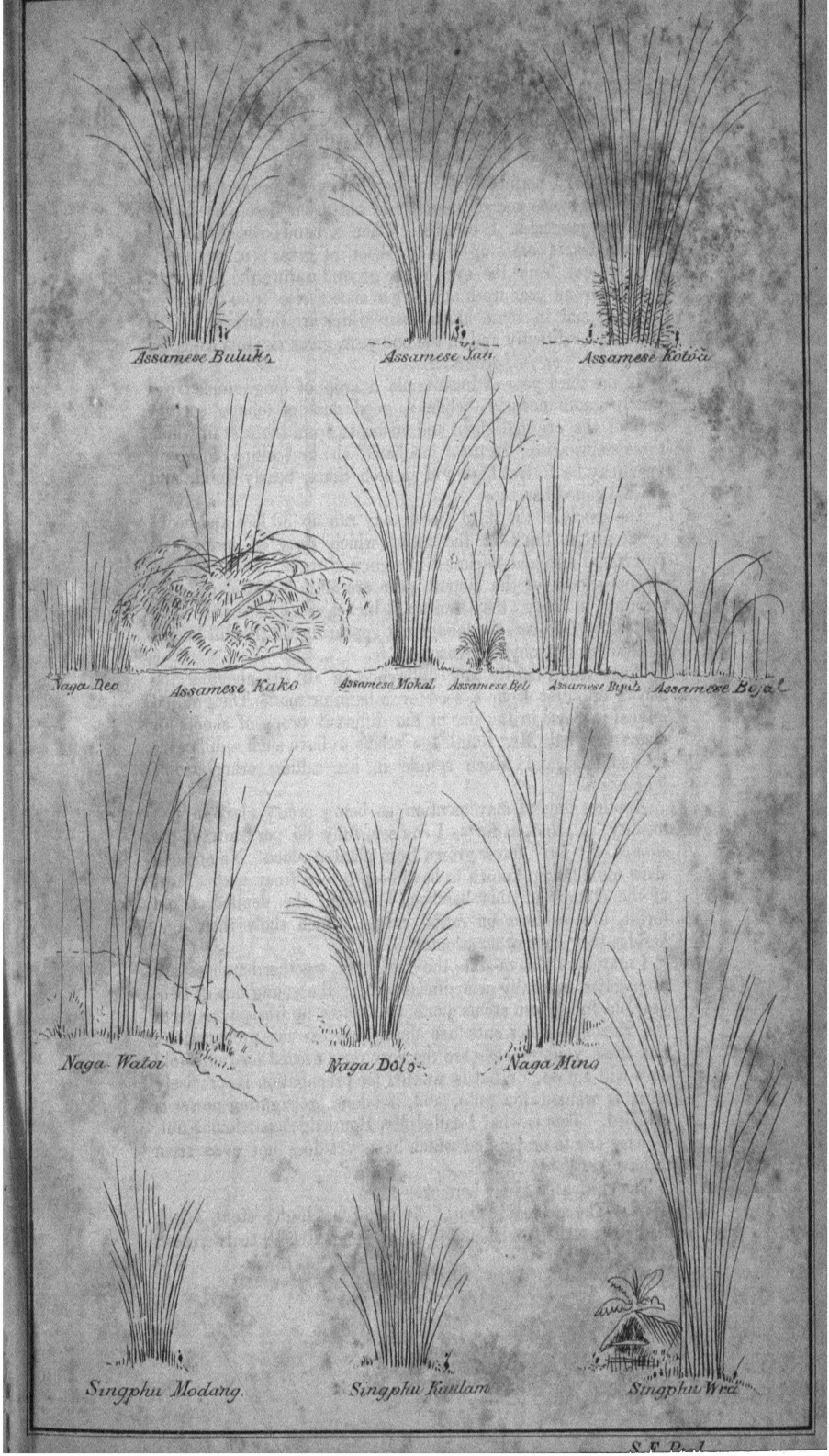
There seems hardly any difference in all the above if the shoots are first from a seed or a halm or root. The gradual annual increase in the size of the different crops of shoots or stems is what Mr. Routledge seems to have such a difficulty in realizing, and which results in his calling other people "ignorant."

Another thing I may mention as being pretty clear in this locality, *i.e.*, that, as far as I can see, fully 95 per cent. of the *clumps* of "jati" have grown from planted roots. No one can show me a clump known to have been grown from *seed.* Most of the clumps of this bamboo, found in the depths of old forest, are *in lines* on raised ridges, which show their age, besides they have other proofs.

I may here also re-state the fact that, whether bamboos are propagated naturally or artificially, it is the young one or two-year old full grown stems alone that throw up fresh stems from the rhizome—older ones are nearly useless for propagation; but these young stems are the very ones needed for pulp—old ones will not do. What is wanted for propagation is precisely what is wanted for pulp, and, if taken, propagating power is crippled. This is what I called Mr. Routledge's particular nut, no easy one to crack, and which he as yet does not even seem to have got hold of.

The cultivated kinds here are—

1*st.*—The aforesaid "Jati," 50 to 60 feet high; stem, 3-inch diameter; walls, midstem, ⅜th inch; stems live 10 to 12 years; clumps to 80.


Assamese Bulukh
Assamese Jati
Assamese Kotoa
Naga Deo
Assamese Kako
Assamese Mokal
Assamese Bel
Assamese Bigul
Assamese Bejal
Naga Watoi
Naga Dolo
Naga Ming
Singphu Modang
Singphu Kanlam
Singphu Wra

2nd.—Buluka, 80 to 90 feet high; stem, 4 inch diameter; walls, say $\frac{3}{8}$th to $\frac{1}{2}$ inch; stem lives 10 to 14 years; clumps unknown.

3rd.—Kotoa (Kaint Wala), 80 to 90 feet high; stem, 3 to 4 inches; walls, $\frac{1}{4}$th to $\frac{3}{8}$th inch; stems live 8 to 10 years; clumps unknown.

Jatis are good for the hundreds of uses we see; Bulukas good for posts; and the Kotoas were always planted along the "bans gurhs," and formed a thorny impenetrable abbattis.

The semi-cultivated and wild kinds are given in the sub-joined table, with their approximate size when mature:—

		Walls At base		Joints.	
1	Kako ... 80′ × 4½″	½″ to 1″	clumped	20″ to 24″	Semi-scandent; foliage coarse and green.
2	Bijuli... 50′ × 2″	¼″ „ ½″	semi-clumped	18″ „ 20″	Straight; bluish stem.
3	Bojal ... 40′ × 1¼″	1/16 to ⅛″ „ 3/16″	not clumped	10″ „ 12″	Scattered in forests; long whips; used for matting floors.
4	Mokal... 70′ × 4″	⅜″ „ 0	clumped	20″ „ 30″	
5	Beti ... 80′ × ½″	1/16″ „ ⅛″	ditto	16″ „ 20″	Climbing; branches incessantly.
6	Watoi... 70′ × 3″	¼″ „ ⅜″	not clumped	30″ „ 40″	Long joints; hills; water tubes, &c.
7	Dolo ... 50′ × 2½″	⅛″ „ ¾″	clumped	20″ „ 25″	Matting for floors and walls.
8	Deo ... 20′ × 1½″	⅛″ „ ¼″	semi-clumped	10″ „ 12″	Do.
9	Ming ... 90′ × 5″	⅛″ „ 1½″	clumped	25″ „ 30″	Water vessels among Nagas. Joints long, green stem.
10	Urd ... 90′ × 7″	⅜″ „ 2″	ditto, dense	10″ „ 15″	Water vessels among Singphus. Stem bluish, joints short.
11	Modang 40′ × 2″	¼″ „ 0	clumped	10″ „ 15″	For building.
12	Kaulam 30′ × 2″	¼″ „ 0	ditto	10″ „ 12″	To cook in.

The properties and economic uses of these are pretty well innumerable, and there can be no use in my detailing even the little I know in regard to them. Viewed solely as crops for paper pulp, I may say that the Bijuli, Bojal, Beti, Deo, Modang and Kaulam are useless, and the most likely for this purpose among the semi-planted ones, in order of the size of stems, are the Urd, Ming, Mokal, Kako; the two first are in the hills semi-planted, and rare, and the Kako is the commonest.

The Dolo and Watoi are in the hills self-sown and common, and are, I apprehend, the same as seen all down south to Aracan; the walls are thin, and hence they would give less material. Of all kinds I should say the Jati or Buluka the best, unless it turned out that the Urd extends rapidly. There are not many clumps in each Singphu village, often only one, but the

demand for it is great, and the people lazy. It is doubtless this same one that extends to China and Burma.

I have planted the Watoi, Deo, Beti, Ming, Modang, Kaulam by halms; the Bojal and Kako, though used, are too common to need planting.

I have also planted the Watoi from seed and seedlings, six inches to a foot high, retaining the grasses and jungle as shade, and simply putting four or five seedlings in a hole, and bending the grass over, as an hour's hot air and sun would kill them. About 10 per cent. lived against about 70 per cent. if put in as halms (two or three years old.)

In all matters, such as the above, I think we should, where possible, assist one another, not only by stating what little we may know, but correcting what are obvious errors; this was my aim from the first. I nowhere profess to know more than a little about bamboos here, and am very willing to learn more. I do *not* believe in controversy, but I do in quietly comparing notes. Mr. Routledge hopes he has enlightened me, and that I will feel humiliated by my ignorance. I thank him for his effort, though where the enlightenment comes in I cannot yet see.

If the Editor desires it, I will answer as many queries as I can; otherwise I have no desire to continue this subject.

S. E. PEAL.

SIBSAGAR, ASSAM,
The 14th June 1882.

[NOTE.—We are much obliged to Mr. Peal for his letter. Mr. Routledge has also been writing to us privately, and the substance of our reply is much what Mr. Peal has now given.—ED.]

Bee-keeping in India.

MOST of us have had to submit a report on this subject in accordance with a late Circular of Government, and few of us, it is to be feared, were able to say much or give information of much value. But some may have had their interest awakened, and they may very likely be glad to read the following letters which we extract from the *Asian* :—

During the latter end of last year a reference was made by the Secretary of State to the Government of India on the subject of the introduction of bee-keeping in this country. The Government of India, in the Revenue and Agricultural Department, addressed a circular letter to all local Governments and Administrations, calling on them to gather all the information available in the districts on the subject. We publish the following correspondence from the Punjaub Government, and the Chief Commissioner of Coorg, which has been placed at our disposal.

From the Government of Punjaub, No. 37, *dated* 25*th January* 1882.

* * * * * *

I am directed to submit the copy of a Memorandum by the Rev. T. Mayor of the Church Missionary Society on his experiences in bee-culture at Bannu, in the Derajat division.

Memo. by the Rev. T. Mayer, dated 7th December 1881.

In tendering my best thanks for letting me see the Government circular (containing an extract from T. W. Thornton, Esq., D C.L., C S.I., to His Honor the Lieutenant-Governor, with reference to bee-farming) it gives me great pleasure to send you some account of Indian bees as far as my own experience goes, and which for guidance and comparison with other places I have, for the information of the Lieut-enant-Governor, roughly illustrated on the appended sheet. So far as I know there are five knds of Indian bees.

No. 1, the commonest and the wildest, is a small black bee with (in the workers) a patch of orange on the anterior part of the abdomen. They build one comb on the branch of a tree, and have a very venomous sting, which is compensated for, however, by the delicious purity and flavour of their honey.

No. 2 is a bee exactly like the English bee, only a little more yellow. It is rare here, but builds, like *Apis australasia*, in hollow trees.

No. 3 is the kind you sent me yesterday from Waziriland (Makin), and is the largest bee I have ever had to do with.

No. 4 is a bee I can only remember having seen about Lucknow and Delhi inside high arched gateways, probably *Apis indica*, but I believe the largest bee in the world, building a comb containing over a cwt. of honey.

No. 5 is a bee I can only hear of from natives, who say it lives like Bombus (our bumble bee at home) in the ground, and whose honey is inferior. My own experience in managing only goes as far as 1, 2, 3. I began in May of this year in my own garden with a wild swarm, cut the branch by night, and firmly secured the comb in a bar-frame hive, fastening the bough with cords. They swarmed next day and were again returned to the hive, in which they afterwards remained until driven out by white ants while I was away in July and August.

I began again on my return in October, got a swarm in, which stayed, added the young brood of some honey that was sent as a present which they hatched out, and also some more honey in the comb. This is now a fine strong hive, and is wintering well. I have secured six since.

No. 2, the Bannuchi Gholanzi, I got from a tree on the Kohat road. We began at 5 o'clock one evening in June to cut them out, but as we had six inches of mulberry to cut through, did not secure the comb till dark. I failed to get the queen, and they all went off in consequence next day.

No 3. The bees brought from Makin yesterday are really domesticated bees. They are very large quiet bees, and are farmed by the Waziris in a "ghurrah" with a piece of leather over the top, into which a hole is cut for the bees to enter.

The Mahsuds and the Afridis also take the greater part of the honey, leaving them enough for the winter, and *putting back all the brood comb*, at least so they all say, though it does not appear how they fasten the brood comb into the "ghurrah" again. After opening this "ghurrah" yesterday I cut out the few remaining combs, and put them in the bar frames, and by night all the bees were fairly settled in their new home. These, if they stay, will make my eighth swarm, all doing well, and being fed during the winter with sugarcandy.

There is no doubt about the profit of bee-keeping if once they can be domesticated; but it is one thing to hive a domesticated swarm, and quite another thing to educate a wild bee. There must be no error in the make of the bars of the hive, and they must be taught to come in by a door, and not from north, south, east and west on to their comb at once. They must be trained to build combs parallel, and I rather doubt if No. 1 will consent to this. However, it will be a great boon if His Honor will take the matter up and encourage the thing. We

might very soon have an excellent Indian Bee-keeper's Journal, and get a full description of all the Indian bees. All the natives here who have seen me working the bees are evidently impressed with the notion that I can do what I like with them, and seem anxious for me to succeed, and very willing to learn. When one gets an extractor made, and show *them* how to take out the honey, and return the comb undamaged, their astonishment will probably reach *its height*. I am sure of this that millions of bees perish every year in this district simply for want of human knowledge. The honey is taken from them at a time when they have probably a brood numbering 2,000 or 3,000 on the verge of coming out. The bees go off, the brood comb is chilled, the parent stock cannot possibly make another comb before the winter sets in, and probably out of a stock of 8,000 bees not 500 survive the winter. It is only owing to the extreme fertility of queens that they are found to survive at all.

Again bees here have great enemies—the lizards, frogs, tarantulas, and last, though by no means least, the chocolate and yellow hornet are their deadly enemies, and give them no rest. Ants, too, are troublesome, notably the large black ant and the white ant.

For prevention from the ravages of the latter I have my hives put on "pucca" stands. Hives for India should certainly be double-walled and double-roofed, and the space between filled up with saw dust, or left free for "dead air." Probably at some future day an earthenware porous double hive, with sand-filled space and a wooden roof will be found best of all. I am sorry I can say so little, but I am convinced the thing can be done, as it will influence in no small way (should bee-farming have a fair trial) the planting of herbs and flowers so as to have a constant succession of food-supply. Mustard, clover, and the flowers of the *Siris* and *Shisham* are among the best. I find bazaar wax so much adulterated with the ends of candles (Ozokerit, &c.) as to be practically useless for putting guides on the bars. The honey too in the market is much mixed with sugar, and often drawn hot from the comb, which gives it a thickened appearance. Possibly next year I may be able to send you a better account of these uncivilized races.

Letter from the Commissioner of Coorg, No. $\frac{17}{18}$, *dated the* 10*th April* 1882.

* *

The quantity of honey produced in Coorg may be roughly estimated at 25,000lbs., of which 14,000lbs. is from the domesticated, and 11,000lbs. from the wild bees. The price realized for the former averages 3 annas the lb., and for the latter, which is of inferior quality, 2 annas the lb. The latter is valued most for the wax. The best wax is sold at 8 annas 8 pie the lb., and that of the ordinary quality at 5 annas 9 pie the lb.

The demand for honey is small. The quantity obtained is absorbed by the local consumption, being used with food by most classes of the people, and as a cooling drink especially on festive occasions. It is used also medicinally. The ryots of Yedavanad, near Somvarpett, who keep bees, sell the honey in the weekly markets in Mysore and South Canara, but not in any large quantity. Some honey is also imported from the Munjarabad Taluk of the Hassan District of Mysore for local consumption.

The right to collect honey in the Government reserved forests is rented out yearly for about Rs. 270. The wax from wild bees is exported by the contractors chiefly to Madras and the ports on the Western Coast. Bees are domesticated by villagers in several parts of Coorg, but chiefly in the Yedavanad of the Naujarajapatna Taluk, and in the Yelusavirshime Taluk. The domesticated variety is known as the Tudvé or Madiké (potjenu). It is a light black bee, with light

grey wings, about the size of the common English fly, and is probably the *Apis florea*. It might be improved by the substitution of the Italian large yellow queen bee, or the ordinary queen honey bee, *Apis mellifica*. The Cyprian or American variety of bee might also be tried to obtain a cross. Some of the European planters might be entrusted with the experiment, and proper bee-hives should be supplied to them. At present earthen pots are used by villagers as bee-hives, with holes pierced in them. At the time the bees are expected to swarm, in the months of January and February, the inside of the pot is rubbed with wax, and they are placed with the mouth of the pot downwards in the jungle. On the bees collecting inside after ten or twelve days the pots are carefully removed at night to the houses of the ryots, where they are kept under the eaves of houses, or under plantain trees. The bees extract honey from the bushes and creepers which are in flower in the jungle. When the honeycomb has formed in the inside of the pot in the months of May and June, the bees are removed by raising the pot up slightly, and blowing them aside while it is dark. These bees do not sting so badly as the wild variety. Few of them are killed in the process. Another pot is usually placed afterwards over the first, into which the bees creep after the removal of the combs, but generally they effect their escape into the jungle. A portion of the honeycomb is generally left in the pot as an inducement for them to return. Occasionally larvæ are found when the ryots delay too long to remove the honeycomb. These are taken and eaten. These bees are found also wild in the jungle in the hollows of trees and in deserted white-ant hills

The varieties of wild bee, besides the partly domesticated Tudvé or Madiké bees, are known as the Hejjenu (the large bee), Kolu or Kaddi Jeneé (the stick bee), and Nasare or Muli Jeneé (the small bee). The Hejjenu is a thin long bee of a dark brown color. They form numerous fine honeycombs on large trees and on rocks, in the months of January, February and March. A jungle tribe called the "Jain" (honey) Kurubars climb the trees at night, and smoke the bees by applying torches. As much as 12 seers of honey is obtained from one comb, and as many as a hundred combs may be counted on one tree. They generally return each year to the same tree, and gather, at times, under the roofs of large buildings. A precipitous rock near Ramaswamikanvé, known as the "Jainkal betta" (honey-hill), is covered with combs each year.

The combs are valued, however, most for the wax, which is exported to the coast. The Kolu or Kaddi Jeneé is a small black bee about the size of a young fly. They are found on hedges and on the branches of small trees. The combs are small and round in shape. They give little honey, and what is obtained is used mostly medicinally as a cure for coughs.

The Nasaré or Muli Jeneé is a very diminutive black bee, which builds its comb in the hollows of trees and in the crevices of rocks. The combs are very small, the wax thin, and both it and the honey, which is slightly acid to the taste, are of a black color. It is mostly eaten on the spot by the herd boys, who search for it when grazing their cattle. Of these varieties none are of any importance except the Hejjenu, first mentioned, which is probably the *Apis dorsata*. It might probably be domesticated. Their habits are not known to differ from those of bees on the plains.—*Asian*.

JJ. Official Paper.

Notes on some trees yielding India-Rubber, by Dr. Henry Trimen, Director, Royal Botanic Gardens, Peradeniya.

India-Rubber or Caoutchouc is afforded by a considerable number of trees and shrubs, chiefly, if not entirely, members of the families *Euphorbiaceæ*, *Artocarpaceæ* and *Apocyneæ*. It is to be distinguished from guttapercha, which is a product of trees belonging to the family *Sapotaceæ*.

In its natural condition in the plant caoutchouc is a milk-like fluid, and the channels in which it occurs occupy a definite position in the structures composing the stem. It is of the highest practical importance to bear in mind that the "milk-vessels" occur wholly in the bark, externally to the cambium-layer or vitally active part of the stem where growth goes on. There are none in the wood, nor in the outer corky, papery or green layers, but only in the inner part of the bark, and either adjacent to or in its bast or liber-tissue.

The kinds of rubber-trees at present exciting interest in Ceylon are:—

(1.) *Ceara Rubber-tree.*—Manihot Glaziovii, *Müll Arg.*

(2.) *Para Rubber-tree.*—Hevea brasiliensis, *Müll. Arg.*

(3.) *Central American Rubber-tree.*—Castilloa elastica, *Cerv.*

These three are all natives of tropical America, and are in cultivation at both Peradeniya and Henaratgoda gardens. The two former are North Brazilian Euphorbiaceous trees; the last is Artocarpaceous, and extends over a wide area from Mexico as far south as Guayaquil on the west coast of South America.

None of these species has been yet subjected to systematic cultivation out of a botanic garden, but the efforts of the Indian and Home Governments, extended over many years, have at length brought us to the eve of that long-desired result. It will, therefore, be well to make public what is known of the nature of these plants, of their surroundings in their native localities, and of the methods by which the product is obtained and prepared. Our information is unfortunately but scanty, being mainly derived from the somewhat meagre accounts of the few travellers who have had the opportunity of seeing the

trees wild, and especially of the veteran collector, Mr. R. Cross, employed by the Indian Government, by whose energy and perseverance they were brought to England.

From these extracts, and from the results of the cultivation of the trees at Peradeniya and Henaratgoda gardens, it is hoped that some answer to the numerous questions recently addressed to me by planters and others may be given, and some guidance afforded towards a successful cultivation in Ceylon.

I.—Ceara Rubber—*Manihot Glaziovii.*

1. *Locality, Soil and Climate.*—Ceara is a coast town of Brazil in Lat. 4° S., and the flat country which runs back to the hills is described by Mr. Cross as manifestly possessing "a very dry arid climate for a considerable part of the year. This is evident from the fact that mandiocca and other crops require to be irrigated. The rainy season is said to begin in November and end in May or June; torrents of rain are then reported to fall for several days in succession, after which the weather moderates for a brief space. According to some statements there are occasional years in which hardly any rain falls. This assertion concurs with the aspect presented by the country in general. The daily temperature on board the ship ranged from 82° to 85° F., but inland it is often probably 90°. The localities traversed by me nowhere seemed to be elevated more than 200 feet above the sea." At Pacatuba, about forty miles from Ceara, the actual place where the specimens were obtained, "the general forest was tolerably high, but the sparse small foliage did not afford much shade from the fierce rays of the sun. The soil was in places a sort of soft sandstone or gravel which was bound up in the most extraordinary manner. Neither grass nor weeds grew among this underwood, and there was an entire absence of ferns, mosses, and other plants." In another place somewhat further from the coast, the traveller shortly after entering the bush-like forest "came on a large tract of land covered by immense masses of grey granite, some of which might be fifty tons or more in weight. These had been broken where they lay, and were the result of a volcanic explosion. Rounded masses of the same rock also cropped out in many places.....Many good-sized rubber trees were growing in the spaces between these granite masses.....' The situation was very dry, but no doubt some seedlings had sprung up, which, owing to numerous thickets of shrubs, were not perceived."

2. *Propagation and Planting.*—Mr. Cross's directions are as follows:—"Seeds are early produced, if the tree is not shaded. They should be buried in brown sand, kept pretty moist until there are indications of growth, when they may be planted out permanently. In some situations where the

ground is rough and strong they might be sown broadcast. Meantime I would suggest the formation of plantations by cuttings, which will take root as easily as a willow. These should be taken from the points of strong shoots and may be one foot in length. In planting, each cutting may be put down in the soil to a depth of six inches. If scarce, the entire shoot may be cut into pieces, each possessing a bud, all of which will grow if covered with half-an-inch or so of soil. On loose sandy soils or exhausted coffee land, plantations may be formed at little expense. Hard, dry, gravelly wastes, if found to support any kind of bush, are also suitable sites. Holes might be made in strong land with an iron jumper and a stout cutting put into each and filled with pebbles. On bare or thinly-covered portions of rock the cuttings might be laid down flat, and a little heap of stones or any kind of *debris*, about the size of a molehill, piled over each, care being taken that the extreme point of each cutting with a bud is left uncovered. I do not advocate planting in an entirely barren desert, but wherever there is any sort of stunted tree or scrub vegetation, with an occasional sprinkling from a monsoon shower, the tree is likely to prosper."

Experience of the plant in the botanic garden here has proved the general accuracy of the above remarks. There can be no doubt of the hardiness of the species, its readiness of culture, and adaptability to circumstances. It grows equally readily from seed or from cuttings; and, though a native of a tropical sea level, thrives well here in Ceylon up to at least a level of 3,000 feet, and on the most barren soils, it has succeeded equally in Calcutta and Madras, but the wet season appears to have killed it at Singapur. It would seem especially adapted for the dry and barren districts of our Eastern and Northern Provinces, or in the higher districts, but it would not be wise to risk it in localities where the temperature is liable to fall below 60° F.

Germination of Seed.—The seed coat is of remarkable thickness and very hard, and the natural process of germination occupies a long period—it is said more than a year. All that is necessary to hasten this, if desired, is to assist the seed-coat in splitting. This is best effected by holding the seed firmly, and rasping off with a file both edges at the radicular end.* It is best not to file off the actual end, as it may thus easily happen that the radicle of the embryo may be injured. After this treatment, properly performed, the young plant appears above ground in two or three weeks. The seedlings require no particular attention. They grow rapidly and may be finally planted out at distances of twenty feet. A peculiarity which they share with their close relative the mandioc

* This end is to be recognized externally by possessing at its side a flat two-lobed appendage technically known as the carbuncle.

is the possession of large tubers on the spreading roots. The trees at Peradeniya, from which seed has been distributed to Burma, India, Jamaica, &c., flowered at the age of eighteen months, and at the present time (at 2½ years) the larger ones form branching trees about 25 feet or 30 feet high, with a stem 1 foot 9 inches in circumference at a yard from the base, and a smooth, silvery, birch-like bark readily peeling off; being about half the size of those which Mr. Cross describes, and which may be assumed to have been fully grown.

3. *System of collecting the Rubber.*—I quote again from Mr. Cross's report:—"This is an operation of a very simple description. On commencing to work the collector takes with him a stout knife and a handful of twigs to serve as a broom. Arriving at a tree, any loose stones or dust are swept from the ground around the base, and some large leaves are laid down to receive the droppings of milk which trickle down. Some do not go to the trouble of sweeping the ground or laying down leaves, for which reason the milk adheres to sand, dust, decayed leaves, and other impurities. The outer surface of the bark of the trunk is pared or sliced off to a height of four or five feet. The milk then exudes and runs down in many tortuous courses, some of it ultimately falling on the ground. After several days the juice becomes dry and solid, and is then pulled off in strings and rolled up in balls or put into bags in loose masses. Only a thin paring should be taken off, just deep enough to reach the milk vessels; but this is not always attended to. Nearly every tree has been cut through the bark, and a slice taken off the wood. Decay then proceeds rapidly, and many of the trunks are hollow. In this condition the trees must yield far less milk, and many no doubt are broken over by the wind or wither away. Collecting is carried on during the dry season only, when rain seldom falls."

Mr. Cross says nothing as to the age of the trees so operated upon; probably the collectors treat all indiscriminately. In the sequel of his report, however, he incidentally remarks that Ceara rubber may be tapped on attaining "a diameter of four to five inches," which is the case here in Ceylon after about two years' growth. But unless there were a very large number of trees in an extensive plantation, this would certainly be labor thrown away. The tree, however, comes so early to maturity, as shown by the production of seed, that it is improbable that it attains any very great size. The process above described must be, if thoroughly done, almost exhaustive of the milk, but in the case of a small stem it would be a work of some care and time to so conduct it as to avoid cutting into the wood, and probably some of the methods afterwards described will be preferred. But these are practical difficulties which it may be safely assumed the ingenuity of our planters will quickly master.

II.—Para Rubber—*Hevea brasiliensis.*

1. *Locality, Soil, and Climate.*—The town of Para occupies a position near the mouth of one of the vast embouchures of the Amazon in about south latitude 1°, but the district of the same name extends over a vast forest region to the south and west, throughout which and the enormous forests of central and northern Brazil this and allied species are abundantly found. The climate has been often described and is remarkable for its uniformity of temperature, usually not exceeding 87° F. at midday, or below 74° at night. The greatest heat recorded is 95°, and the mean for the year is 81°.

The rainfall occurs principally during the months from January to June, the maximum being in April, when it reaches 15 inches. For the remaining six months of the year very little falls, but there are fine days in the wet season and occasional showers in the dry. The whole country is covered with dense moist forests, and the soil near the numerous and gigantic rivers is deep, heavy, and very fertile. During the wet season much of the low-lying country near the Amazon's mouths is flooded. In the *gapos* near Para, visited by Mr. Cross, he found a flat district only three or four feet above the highest tides and completely intersected with water-courses at low tide, filled with a soft rich mud. The forest here, in which caoutchouc-collecting was vigorously carried on, was 80 or 100 feet high, and very damp and unhealthy, the soil full of moisture and very rich and fertile. The young plants, however, were not often observed to grow actually within the reach of the tides, but it is evident that they must frequently be subject to be partially covered with water.

2. *Propagation and Planting.*—This valuable species as yet has been propagated from cuttings only. No fresh seeds were brought to this country, but to judge from dry ones in the herbarium of the British Museum, London, they are considerably larger than those of the Ceara rubber. Our largest trees at Henaratgoda, three years old, are thirty feet in height, with a slender stem scarcely branched, and about twelve inches in circumference near the base; but neither there nor in Peradeniya have they shown any symptoms of flowering.

Cuttings may be taken from the green lateral twigs as soon as they begin to harden; they strike readily in rich firm land. Mr. Cross observes that "for planting on inundated lands the period of high flood should be preferred. Cuttings of greater length would be required in this case, the lower ends of which should be sliced off in the form of a wedge. The workman could take a bundle of these, and wading into the water would plant at proper distances, but perfectly upright, taking care to push each cutting down deep enough in the soft muddy bottom, so that not more than three or four inches is above the surface

of the water. The same rule would be applicable when planting in sludge or soft marsh land. The crowns of the cuttings must not, if possible, be put under water, as the young growths springing therefrom might rot. Seeds will not be found very applicable for planting in watery places or deep mud deposits. Some would come up, but a good many would mould and decay. In the varied course of circumstances and conditions, slight changes and modifications in the methods of working will no doubt suggest themselves.....It should be planted in places where nothing else could be profitably cultivated, such as frequently inundated river margins, marsh land, and mud deposits." It would not be desirable to form a plantation in any locality where the temperature at any time falls to 60° F.

The tree when fully grown does not exceed a height of about sixty feet, and the largest trunk measured by Mr. Cross was six feet ten inches in circumference at a yard from the ground. From the upright habit of the tree it will not be necessary to plant at any great distance apart.

Over 500 plants have been sent from Ceylon to Burma and some to the Madras Presidency. An attempt to grow the tree in Assam failed.

3. *Collection of the Rubber.*—Several accounts have been given of this, the fullest and most recent being that of Mr. Cross, who saw in practice the methods employed in the neighbourhood of Para. His description is as follows:—

"The collectors begin to work immediately at daybreak, or as soon as they can see to move about among the trees. They say the milk flows more freely and in greater quantity at early morn. I do not attach much importance to this statement, but I have recorded it. Another and more probable reason is, that as rain often falls about two or three o'clock in the afternoon, the tapping must be done early, as in the event of a shower the milk would be spattered about and lost. The collector, first of all, at the beginning of the dry season, goes round and lays down at the base of each tree a certain number of small cups of burnt clay. At the lesser trees only three or four are put, but at the larger ones from eight to twelve are deposited. The footpaths leading from tree to tree are likewise cleared of sapling growths, and the bridges over the *gapos* (natural ditches) formed at each place by the trunk of a tree are, where necessary, replaced. On proceeding to his work the collector takes with him a small axe for tapping, and a wicker-basket containing a good-sized ball of well-wrought clay. He usually has likewise a bag for the waste droppings of rubber, and for what may adhere to the bottoms of the cups. These promiscuous gatherings are termed *sernamby* and form the "negrohead" of the English market. The cups, as already stated, are of burnt clay, and are sometimes round, but more frequently flat or slightly concave on one side, so as to stick easily, when with a small

portion of clay they are pressed against the trunk of the tree. The contents of fifteen cups make one English imperial pint. Arriving at a tree the collector takes the axe in his right hand, and striking in an upward direction as high as he can reach, makes a deep upward sloping cut across the trunk, which always goes through the bark and penetrates an inch or more into the wood. The cut is an inch in breadth. Frequently a small portion of bark breaks off from the upper side, and occasionally a thin splinter of wood is also raised. Quickly stooping down he takes a cup, and pasting on a small quantity of clay on the flat side, presses it to the trunk close beneath the cut. By this time the milk, which is of dazzling whiteness, is beginning to exude, so that if requisite he so smooths the clay that it may trickle direct into the cup. At a distance of four or five inches, but at the same height, another cup is luted on; and so the process is continued until a row of cups encircle the tree at a height of about six feet from the ground. Tree after tree is treated in like manner, until the tapping required for the day is finished. This work should be concluded by nine or ten o'clock in the morning, because the milk continues to exude slowly from the cuts for three hours or perhaps longer. I may state that there is a great difference among collectors in the performance of these duties. Some take care to get good clay previously and incorporate it well, so that a very small portion is needed to lute the cups to the trunks; they also work with neatness and intelligence, and invariably collect a good quantity of milk. Others, again, do not take the trouble to prepare clay beforehand, but merely scrape up a handful when they require it at the side of a *gapo*, which is often of little consistence, so that a large quantity is required to fasten the cups. This class of collectors have often many fragments of clay or other impurities in their milk, the result of not following a proper method of working. The quantity of milk that flows from each cut varies, but if the tree is large and has not been much tapped, the majority of the cups will be more than half full, and occasionally a few may be filled to the brim. But if the tree is much gnarled from tapping, whether it grows in the rich sludge of the *gapo* or dry land, many of the cups will be found to contain only about a tablespoonful of milk, and sometimes hardly that. On the following morning the operation is performed in the same way, only that the cuts or gashes beneath which the cups are placed are made from six to eight inches lower down the trunks than those of the previous day. Thus each day brings the cups gradually lower until the ground is reached. The collector then begins as high as he can reach, and descends as before, taking care, however, to make his cuts in separate places from those previously made. If the yield of milk from a tree is great, two rows of cups are put on at

once, the one as high as can be reached, and the other at the surface of the ground, and in the course of working, the upper row descending daily six or eight inches, while the lower one ascends the same distance, both rows in a few days come together. When the produce of milk diminishes in long wrought trees, two or three cups are put on various parts of the trunk, where the bark is thickest. Although many of the trees of this class are large, the quantity of milk obtained is surprisingly little. This state of things is not the result of overtapping, as some have stated. Indeed, I do not believe it is possible to overtap a tree if in the proportion the wood is not left bare or injured. But at every stroke the collector's axe enters the wood, and the energies of the tree are required in forming new layers to cover those numerous wounds. The best milk-yielding tree I examined had the marks of twelve rows of cups which had already been put on this season. The rows were only six inches apart, and in each row there were six cups, so that the total number of wood cuts within the space of three months amounted to seventy-two. It grew close to a *gapó* only eight inches above high-tide mark, and being a vigorous tree the cups were usually well filled, but with two years or so of such treatment the tree would probably be permanently injured. It has been supposed that the quality of the milk is better in the dry season than during the rains. Such is the case with some vegetable products, but as regards India-rubber there ought not, I think, to be any appreciable difference. In the rainy season the milk probably contains a greater proportion of water, but, on the other hand, I am of opinion that then a larger quantity of milk flows from the tree. No doubt the dry season is the most suitable for caoutchouc collecting, although wherever a plantation is formed with preparing house convenient tapping may certainly be always carried on when the weather is fine.....There are two other methods adopted in tapping which are chiefly confined to the Upper Amazon and tributaries. Both are exactly on the same principle, the materials used being only a little different. The loose outside bark of the tree is cleaned off to a height of about three feet. Beneath, a gutter or raised border of clay is pasted or luted to the trunk, enclosing one-half of the entire circumference. Cuts are thickly made in the bark above this, from which the milk flows down to the gutter, whence it is conveyed to fall into a calabash conveniently placed. The other mode is by winding round the trunk the stout flexible stem of a climber, and claying it round securely so that no milk may escape between the trunk and the climber. These plans are not extensively adopted, and can only be successfully put in practice where the trees have not been previously tapped. There is always a great deal of "negro-head," the result of the distance the milk has to run, and to the large quantity of clay employed in the process.

"*Collection of the Milk.*—Going from tree to tree at a sort of running pace, the collector empties the contents of the cups into a large calabash, which he carries in his hand. As he pours the milk out of each cup he draws his thumb or fore-finger over the bottom to clean out some which otherwise would adhere. Indeed a small quantity does remain, which is afterwards pulled off and classed as *sernamby*. The cups on being emptied are laid in a little heap at the base of each tree, to be ready for the following morning. The trees occur at various distances from 10 to 100 yards apart, and as I travelled over the intricate net-work of muddy footpaths, I continually felt perplexed and surprised that the natives have not yet seen the advantages that would be derived by forming plantations, whereby more than twice the quantity of caoutchouc might be collected in one-fourth the time, and at far less cost and labor."

The trees are tapped if they have a circumference of eighteen or twenty-four inches, and the rough process above described is carried on for many years, until the constant and extensive injury to the young wood causes their death, for some years previous to which event they almost cease to yield milk and are practically abandoned.

It will be advisable, in order to avoid this injury, to employ an instrument for cutting so shaped and guarded that it shall not be able to penetrate beneath the inner bark. With this precaution it will probably be found unnecessary to rest the trees as has been recommended by some; but actual experience alone can decide on the method of tapping which will secure the greatest yield with the least damage to the tree's general vitality.

III.—Central American Rubber-tree —*Castilloa elastica.*

1. *Locality, Soil and Climate.*—The very extensive geographical range of this tree shows it capable of existing under considerably varied climatal conditions. The forests in which it grows are usually at or near sea-level, but it has been observed at an elevation of 1,500 feet on the Pacific coast. The soil varies, but the plant avoids marshy or boggy land, appearing to prefer warm, deep loam or sandy clay, and especially affecting the margins of small running streams where it grows in little groups. A dry or a rainy climate seems equally suitable, but a high and equable temperature, which does not sink below 60° F. at any time, is essential.

2. *Propagation and Growth.*—This is a very much larger tree than those above described, being, when fully grown, of the imposing height of 160 to 180 feet, with a stem of 12 to 15 feet in circumference. It grows very rapidly. At Henaratgoda at two years of age it was 23 feet in height. The bark is thick, and the wood soft and readily decaying. We received but a few plants of this species in Ceylon, and have had little

experience in its management. No flowers have been yet produced, and Dr. Thwaites did not find cuttings of the ordinary kind to succeed well. We are now however endeavouring to propagate at Peradeniya by various other methods.

Mr. Cross has the following remarks:—"Trees in good situations will produce seeds early, but these will require to be planted without delay as drying destroys their vitality." The tree is stated to flower in January, and the fruit to be ripe in April. "Stout branches, cut into pieces, each possessing a bud and covered lightly with soil, will generally be found to grow. Strong cuttings, a foot in length and furnished with buds, when planted in the usual way, will become strong plants sooner. However, the propagation of this tree will not be found so easy as the Ceara rubber. In the planting out of young plants, the petiole or leaf-stalk of the lowest or oldest leaf should be buried in the soil. By following this simple rule the plant commences to grow at once, its growth is vigorous, and the trunk symmetrical. But if at the period of planting there is much bare stem above ground, then growth is usually slow, the plant remains 'leggy' for some time afterwards, and never makes a good tree." The plant has a curious habit of dropping its young branches, which disarticulate by a regular joint, like deciduous leaves, and leave a clean scar on the surface of the stem. From what has been said above as to its native sites, it would seem that our south-western coast would present many favorable localities for this valuable tree.

3. *Collection of the Rubber.*—Milk is abundant and flows readily, but it is of a somewhat more watery consistence than that of the Para rubber. In consequence of the large size of the trees it is the practice of the collectors in Panama and other parts to cut them down. A groove or ring is first cut round the base of the trunk and the milk received into large leaves. "The tree is then felled, and rings or channels are cut out around the prostrate trunk at about twelve or fourteen inches apart," and the rubber allowed to run into leaves or vessels. In Nicaragua the trees are tapped with sharp axes in various ways, and the trees so much injured that the process is performed at intervals of three years. The milk is received into iron pails. It does not appear that this species is tapped until it has a diameter of sixteen or eighteen inches, which Mr. Cross thinks might be attained in six years.

In conclusion, a few words may be said about the preparation required to fit caoutchouc for the market. It is clear that mere exposure to the air is sufficient in some cases to effect the coagulation of the milk into a solid mass. This is all the preparation apparently that the Ceara rubber receives, which comes into the market in balls consisting of the rolled up strings pulled off the tree. But it seems that a decomposition is liable to occur in the milk if exposed in any quantity, and

it is usually desirable to reduce it to a solid mass as quickly as possible. For this purpose the cautious application of dry heat is the best; the best Para rubber is prepared by being poured over a flat paddle-shaped mould, which is held in the thick hot smoke from burning wood and palm-nuts till it solidifies, then slit down one side, the mould taken out and the "biscuit" hung up to dry. In several parts of Central America coalescence is effected by the addition to the milk of the juice of certain plants (especially of *Calonyction speciosum*, which is a common convolvulus here in Ceylon). This causes the separation of the caoutchouc, which floats in the liquid like a mass of soft cheese, and has to be pressed and rolled to get rid of the fluid still remaining in its substance.

Probably carefully conducted evaporation in shallow pans by artificially regulated heat would be found an effective method.

The purity of the prepared rubber being a matter of first importance, all pieces of bark and earth should be removed by passing the milk through sieves. Small pieces or thin sheets of caoutchouc are preferred to large masses in the market from the facility of estimating the purity of the article.

Absolute dryness of the rubber is also a point requiring the greatest attention, and may require hydraulic pressure for its thorough attainment.

As much as 129,163 cwts. of caoutchouc were imported into England in 1874, of which 70,866 cwts. was American and obtained from the plants here under consideration. The value of this latter was £1,007,413. The demand for the best sorts is constantly increasing. On the relative market values of the various kinds of India-rubber reference may be made to the excellent "Report on the Caoutchouc of Commerce" by Mr. Collins, and printed for the Indian Government in 1872, to which I am indebted for some of the above information, and to a paper by C. R. Markham in the "Journal of the Society of Arts" for April 7th, 1876.—(*Mysore Gazette.*)

JJJ. Reviews.

The Journal of Forestry and Estates Management.

The number for April contains an interesting paper on *Curious and Historic Trees*. It is illustrated, some of the pictures being as good as possible (*e.g.*, the Burnham Beeches in winter), and others as bad.

The Indian Forester will not derive much information from the article on forest fires. Attention should, however, be paid to the diagram on page 851. In India, wherever wood fuel is used by railway engines, the risk from the shower of sparks or burning flakes is much greater. Also the effects of fire, as noted at page 850, would be very different after the fire have passed over some of our grasses 15 feet to 20 feet high.

M. Boppe's report on the English and Scotch forests is reproduced. This valuable paper ought to convince any rational person how hopeless it is to expect the English forests to serve as models for forest teaching. The English idea of forestry is, and always must be, totally different from that of countries where large natural forests have to be managed. Here we never require to manage places for ornament; we rarely have compact areas of plantation fenced and gated. We want our people to get thoroughly imbued with the *idea* of a forest estate, in which natural reproduction is, *under the circumstances*, the most important plan because we cannot afford to do otherwise. It is surprising how English foresters misunderstand the application of "natural reproduction" methods. *If it* pays, artificial reproduction is not objected to. In Germany, *because* the forests are now in a paying condition, artificial reproduction is very largely resorted to; but in a large extent of poorly paying natural forest, nearly all our work *must* be directed to natural methods, because we cannot afford to do otherwise. Be this as it may, it is not only that natural reproduction is to be properly appreciated, but the idea of a forest as such, to be assimilated, the whole area being managed with a definite object, while effort is made to bring it more and more into an ideal condition as regards admixture of species and gradation of ages. This can be described in books, and verbally explained in the class room; it will never be realized in the mind, and grasped in its integrity without a study on the spot: without seeing estates worked for those objects, and by people to whom the idea

of the thing is thoroughly familiar. No one in England ever has, or ever understands, the idea, as can be plainly read between the lines of M. Boppe's genial but honest report.

The reader will be interested in noticing that the Californian "Big-tree" must quite give way before an Australian "Bigger tree." Here (at page 872) we have a notice of a specimen of *Eucalyptus amygdalina, accurately measured*, and growing a height of 380 feet without a branch, the total height being 430 feet, and the girth 60 feet, at "some distance" from the ground.

COLONEL PEARSON'S paper on "The Teaching of Forestry" is also printed. Not a bad paper either, with this important exception, that having told us what is to be taught, he stops just before the difficulty, *viz.*, *how* to teach it, and how to get the plan realized and thoroughly assimilated in a class room at Cooper's Hill, in a country where there is not an acre of forest where *any one* of the conditions can be shown to have been realized, or to be in the process of realization.

Among the papers in the EDITOR'S BOX, some notices of remarkable growth of trees will be found. Notably at Oatlands (Navan, Ireland) deodars are mentioned which, at *twenty-two* years of age, were 38 feet high, and five feet five inches at ground girth, and four feet two inches at five feet from the ground. This is no doubt why the deodar is no good for timber in the British Islands; in the most favorable localities in its natural home, the tree would never attain this girth with such a relatively diminutive height at all, to begin with; and the girth indicated could not be attained in double the time. A note at page 898 is interesting, as showing how carbolic acid will destroy or greatly retard the germination of seeds.

In the MAY number we commend a paper on "Woods and their Management," to show what we have remarked, how totally unable all English foresters are, either to understand, or to bring home to their minds the absolute difference between "forestry" as required by them, and that which is required on the Continent, and in India.

No one supposes that two years at any forest school *completes* training: it merely lays the foundation of it in right ideas, and a thorough appreciation of the end and aim, the methods and the obstacles, with regard to *natural* forest management, which as little as possible resembles that of the gated and fenced "plantation," the groups of trees, the park growths, or the haphazard arboriculture (which bad legislation has necessitated) in Crown-forests, which are the "forests" of England and Scotland.

MR. MCCORQUODALE'S paper, or rather series of papers, on thinning and pruning of forest trees, is continued in this number, and will well repay perusal.

In this number will be found what is (facetiously perhaps)

called the "Discussion" on Colonel Pearson's paper. Considering that not one of the speakers showed the smallest appreciation of, or made the least allusion to the real difficulties of the question of forest training, and that not one of the gentlemen present, eminent as they may be in botany and other sciences, have any practical or even theoretical knowledge of the subject, this discussion was not very valuable: a little rhapsody from Sir R. Temple, some appropriate but not very new remarks about the dangers of forest destruction, the condition of Cyprus, &c., &c., &c., and that is all. Anything more utterly barren and useless to call a "discussion," on a subject of the most vital importance to our Indian forests, we never read.

The June number we notice a change in the Management of the Journal. It now appears under the Editorship of MR. FRANCIS GEORGE HEATH, well known as the author of several pleasant books about trees, and editor of a modern edition of that charming book, originally brought out with quaint tinted illustrations in the end of last century, "Gilpin's Forest Scenery."

Epping Forest naturally occupies a prominent place in this number. There is also an article on "Forestry in France" by Colonel Pearson, which is a sort of study or review of BROILLARD, BAGNERIS, &c., &c. We doubt the utility of these short abstract notices to any forester, and to English foresters they are quite useless, unless they lead to a study of the matter in detail.

A paper on "Remarks on M. Boppe's Report" is only one more proof of the hopelessness of getting English foresters to understand the Continental method; or that it is *not intended* to be applied to gardens and plantations and *arboreta* in palings. It is curious to note how completely the writer has been unable to understand what is meant by "constant annual revenue," by "continued improvement in production" and by natural reproduction. He does not want these ideas;—quite true; they are *not* essential to his forestry;—natural reproduction is quite an occasionally useful thing, and to his method of working, and with the results he obtains, by no means of pressing importance: quite true again, that these matters are, on the Continent and in India, life or death matters; the whole success of our administration depends on them, and that is why we object to Indian foresters being sent to Cooper's Hill or a school of "forestry," without forests or *foresters* (as we understand the term). We know that unless our men start with *right ideas* they will never get them afterwards. Forestry in England is diametrically and absolutely different from forestry in the large natural, unfenced, heavily-burdened, forests in India. But forestry in India is essentially the same, in its principles, its methods and its aims as the forestry of the Continent.

Forest Administration Report of the Bombay Presidency for 1881-82.

Since writing our review of the India Reports in the April No., p 401, we have received that for Bombay and Sind, which is a publication that, comet-like, makes its appearance in Northern India only after rare and variable intervals of time. Still more erratic is the Madras one. The library records of our office shew that we have, since the Department was instituted, received one or two old Madras Reports, and an occasional Bombay one. The last of the latter was somewhere about 1878, and was an octavo volume, while this is the usual foolscap-size green-bound pamphlet, to whose appearance we have grown accustomed. It seems to us that the whole system of publication of these reports, and of the similar-looking reports of the Inspector-General, is wrong. In the first place the size is a mistake. In the annual reports, which contain a number of forms, it may be inconvenient to use too small a size, but for publications likely to be of general interest, like Dr. Brandis' "Suggestions," surely it would be better to print them in a smaller type, and of a smaller size, say octavo. Then we could put them on our library shelves with some chance of their standing by their own weight, and they would, for all but those who like to have foolscap size, because they can double up their report in two, and tie it with other official papers in a bundle, be much more handy to read and consult. But there are very few indeed who require to put them in official bundles, compared with the great number of readers; and we venture to suggest that it would be a great thing if, instead of the large staring type and frequent blank spaces of our reports, and the foolscap size, they were to be printed in smaller type like that of an ordinary book or newspaper, and issued in octavo size, they could be bound in yearly volumes, and take their place on our library shelves in a form which would be convenient and admit of easier reference. And why should not some proper system of distribution be made? Formerly we used to get combined volumes which were very useful, the only mistake being that too many were published, and that they were sent to divisional, and even sub-divisional, offices, where they blocked up the meagre accommodation available, or got thrown into corners to be eaten by rats and white ants, or destroyed by mould. Now we get separate reports which we bind ourselves, but here unfortunately it very frequently happens that one or two do not come, and so the set is spoiled. What in our opinion would be best would be to have the combined volumes (we all like to know what is going on in other provinces) and to print them smaller and in a smaller size. Hundreds of copies need not be distributed, but some half dozen to each province might be sent direct to the Conservator, who would circulate

them for perusal, and for eventual file in the libraries of a few of the more important divisions which are likely to be permanent. There is no good sending publications to divisions which are not likely to be permanent. Such publications as as Dr. Brandis' "Burma and North-West Provinces" Suggestions would have twice their value if they were neatly got up in octavo size, and printed in smaller type, bound more strongly, and made capable of being placed on a library shelf of modest dimensions. We see that the proofs of the "Manual of Sylviculture" are in foolscap size, and we trust this is only preliminary, and that the book will eventually be of more convenient dimensions. Then, too, as regards publishing the general volume, why should not Madras and Bombay be included, and the whole bound up in three ordinary volumes—the first, say, with Bengal, Assam and Burma; the second with the other Northern Provinces; and the third Bombay and Madras, and distributed in a convenient size and shape? At an average of six copies to each of the 15 circles, under 100 copies only would be required for circulation. We owe apology to our readers for starting this subject at the beginning of a notice of the Bombay Reports, but hope they will excuse it. We will make no more digressions but return to the point.

The area of forest in Bombay is—

	Reserved Fts. Sq. miles.	Protected Fts. Sq. miles.	Total. Sq miles.
Northern Division	7,771	1,870	9,641
Southern Division	955	3,663	4,618
	8,726	5,533	14,259

That of Sind is not given.

In the Northern Division the chief forest districts are Khandesh, Thana and Násik; and the Southern Division, Kanara, all these having over 1,000 square miles.

The general system of working so as to supply the requirements of the population is thus described for the Northern Circle:—

"The chief requirements of the people in the shape of forest produce are—

(*a*). Timber of small size for house-building, agricultural implements, and petty industries.

(*b*). Firewood.

(*c*). Rab material.

(*d*). Grazing and grass.

"Very extensive departmental fellings of teak trees, babul and jungle wood are made in all the districts of the Northern Division, and the wood is stacked and sold by public auction, as a rule, to the highest bidder, and at many of these auctions the cultivators and people of the district are enabled to purchase the wood they require. In the Kolaba District 46,397

teak trees were felled in 39 forests scattered over the whole district and selected for the purpose, so as to form centres of groups of villages. These trees produced 59,483 teak logs, rafters and pieces, and 2,164 khandis of firewood; all this material was sold by auction in small lots. In the same way in the Deccan, Gujarat and Ratnagiri the material is disposed of lot by lot, so that men of small means can compete against traders, and that any person may select and buy the description of wood required. In the Thana District this system is not so much practised; there the wood is sold by auction or tender in lump, but the people of this district have many other sources of wood supply; the Jawhar forests close at hand are extensively worked; inamdars' forests scattered all over the districts are being carried wholesale into the market; malki numbers with rights over trees vested in their occupants are being stripped; and wood dealers, big and small, are legion. Besides free grants are made for ploughs, &c., from trees on malki numbers over which the rights of Government have been reserved at the survey settlement. However, the system of temporary auction depôts for the sale of small lots will also be introduced into Thana next season. Alienated forests and private forest and tree properties contribute to supply the local requirements of the people in all districts where there are trees remaining in inam forests and on occupied survey numbers.

"Firewood is also provided by departmental fellings and sales, by contract sales, by a permit system, and from inam and private forests. The villagers whose lands are included in forest reserves are permitted to remove, free of charge, dead fallen wood. Head-loads of dead wood are allowed to be taken by the poorer classes for sale in towns and large villages either free or on payment of a very small fee.

"Regarding rab material, forest villagers are allowed to cut and remove free of charge, grass, and in some cases certain kinds of vegetation, in certain classes of forests; for instance, from the "Protected Forests" of Kolaba they are allowed to cut and remove 28 kinds, in Poona all but 20 kinds in the old gairan lands of the ghat talukas are permitted to be taken.

"Grass and grazing is generally free to forest villagers, and to others on payment. The karvi, *Strobilanthes*, having flowered this year in the Konkan forests, cattle being very fond of the flower were allowed to graze upon it."

And it is interesting to see that the system of direct sales by public auction, the actual fellings being made by the Department, is considered the best, for in Bombay also, as in some provinces of Northern India, it would scarcely seem that direct departmental timber workings really pay. The following extract from the Government Review regarding the Kanara Saw Mills will explain itself, and require no comment:—

"The Kanara Saw Mills have been worked at a loss of

Rs. 102 during the year under review, the receipts being Rs. 33,163, and the expenditure, including a percentage on capital outlay for deterioration of stock, being Rs. 53,265. In the previous year the loss was shown as Rs. 2,223, but then the difference in the value of round and squared logs was not taken into account as it should have been, and as it has been this year. The defect which was referred to in a Government Resolution as a cause of loss in the working of the Mills was not the supply of round timber, as Colonel Peyton appears to have interpreted the Resolution, but the supply of a bad quality of timber, which was inferred from the large proportion of wastage as compared with that of the previous year. It is quite true, as the Conservator states, that one of the objects of getting the saw machinery was the utilization of outside slabs and what in preparing logs for the depôts would be wastage; and, although the demand for such slabs is not at present great, Government do not desire to interfere with Colonel Peyton's discretion in getting such kinds of logs supplied to the Mills as he considers most advantageous. The plan adopted by Colonel Peyton of utilizing the outside slabs by making of them the ordinary native stools, for which there is a great demand, is one of many proofs of the ingenuity with which he makes his Department minister to the wants of the people with profit to itself."

Saw Mills.

The progress of fire-protection works seems to have been very fair, as is recorded in the following extract:—

"Increased attention has been given during the year under review in the Northern Division to the important work of protecting forests from fire. No less than 84·75 per cent. of the whole forest area has been guarded by fire traces, and in some districts, notably Poona and Satara, there has been a marked decrease of forest fires, which the Conservator, Northern Division, regards as evidence that there is no real ill-feeling between the Forest Department and the people. The Dang forests in Surat, on the other hand, almost all the forests in the Mandvi Taluka of that district, and half the forest area of the Panch Mahals, were traversed by fire. The proportion of the whole forest area of the Northern Division which was burned was about 14 per cent., from which it is evident that there is still room for improvement. In many cases the fires were no doubt caused wilfully, and some persons were prosecuted and punished on that account. His Excellency in Council fully concurs with Mr. Shuttleworth that it would not be just or politic to punish wild Bhils who set fire to forests without knowing the grave consequences of the act; but efforts should be made to convince as many of them as possible as well as of the Warlis, Katkaris and Kolis of Thana that the action is criminal, and will, if

Forest fires.

persisted in, lead to severe punishment. In the Southern Division forest fires were numerous, though in Dharwar fewer than usual. The Conservator says they are often purposely caused by people who consider the grass is otherwise spoiled by white ants, and for the purpose of protecting lands from which brushwood is taken for manure. The measure of repression proposed by Colonel Peyton, *viz.*, to forbid grazing and the removal of forest produce from forests which have been burned, is severe; but if the villagers neglect the warnings which are given to them, it may be necessary to resort to it. It is gratifying to learn that in Belgaum the people readily assist the guards to extinguish fires, and the people of two villages in Sholapur were rewarded for their efforts to repel an immense fire which approached from the Nizam's territory. In Sind, fires were more extensive than in the previous years owing to the low floods and the early fall of the river. The Conservator is not hopeful of the effect of any protective measures which can be carried out within a reasonable cost, but Government trust that the subject will continue to engage his attention."

It is interesting to learn that in Sind the *Prosopis glandulosa* has already shewn itself to be a most valuable fodder-tree giving two crops of pods yearly.

The forest results of Bombay were—

	Receipts. Rs.	*Expenses.* Rs.	*Surplus.* Rs.
Northern Division	6,12,710	5,03,304	1,09,406
Southern Division	4,82,252	3,12,627	1,69,625
Sind	4,27,845	2,99,165	1,28,680
	15,22,807	11,15,096	4,07,711

JY. Timber Market.

CALCUTTA.

Rangoon Teak.

Mast Pieces, good large	... Rs.	5 to 12 per running foot	...Quotations nominal.
Sawn Timbers ...	.. „	80 to 100 per ton	... Ditto.
Planks, long lengths	... „	110 to 120 do.	...
Sheathing Boards, ½ inch	„	110 to 120 do.	... Ditto.
Ditto ¾ inch			
Boards 1 inch	... „	105 to 120 do.	...

Moulmein Teak.

Square Timbers, 20 to 29 feet long, 10 to 13 inches square, first-class	Rs.	90 to 120 per ton of 50 cubic feet.	
Ditto, 20 to 45 feet long, 14 to 18 inches square	... „	120 to 175	ditto.
Second-class Timber ...	... „	90 to 98	ditto.
Planks, long lengths, first-class	... „	110 to 120	ditto.
Furniture Planks, 18 to 36 inches broad, and 1 inch thick—good	... „	130 to 150	ditto.
Sheathing Boards, ½ inch, double	„	130 to 135	ditto.
Ditto ¾ inch	... „	110 to 140	ditto.
Scantlings (of sizes) ...	... „	60 to 125 per ton.	
Moulmein Cedar, Square Timber	... „	65 to 70 „	
Thingan and Consohr	... „	45 to 50 „	Nominal.
Peemah	... „	55 to 75 „	

American and Colonial Timber.

American Lumber	... Rs.	0 to 0 per 1,000 supl. feet. of 1 inch thickness.	Market bare.
Mast Pieces, large,	... „	4 per running foot.	Nominal.
Spars, large	... „	1-12 per do. do.	Ditto.
Mahogany	... As.	6 per supl. foot of 1 inch thick.	
Ash Oars	... „	5½ to 6 per foot.	
Sal, small	Rs.	65 to 110 per ton	
Do. large			

Stock of Teak in Calcutta on July 1st—4,170 tons.
—*Mackenzie, Lyall & Co.'s Circular.*

HOME MARKET.

Mauritius Ebony	... £ 4	per ton.
Ceylon „ ...	... „ 10	„
Cocus wood ...	... „ 2-10	„
Olive wood ...	... „ 3-15	„
Myall wood ...	... „ 2	„
African blackwood ...	.. „ 1-15	„
West India boxwood	... „ 1	„
Mahogany, Honduras	... 7½*d.*	per foot.
Do. Cuba ...	... 5¾*d.* to 6¼*d.*	
White Cedar ...	.. 1*s.*	per foot.

—*Timber Trades' Journal.*

The same paper also speaks as follows regarding the Burma Teak Market:—

Messrs. Denny, Mott & Dickson inform us that the position of the market remains substantially unaltered since they last reported in March. Prices in Burma have been progressively hardening, and shippers do not find much reason to anticipate that the new season's wood will cause lower rates. Foresters still indicate short supplies and stiffer prices, and as their financial position has been undoubtedly strengthened by the profitable prices they have secured during the past two years, they are now to some extent mas ters of the situation and can afford to hold their stocks for some time to come if their views of price are not acceded to. They are well informed as to the charters for teak cargoes concluded on this side, and also doubtless as to the briskness of the demand for teak in Europe, for rolling stock and ship-building purposes, and at the same time the consumption in India is so great just now that the foresters are more than usually independent of the European market. Freights from Burma to the United Kingdom are slightly easier, the high prices tending to check forward charters.

V. Notes, Queries and Extracts.

North Carolina, and its Forests of Pine.—A writer in the *Lumberman Gazette* says:—"In most of the Gulf states the chief industry of the people is cotton culture, and that determines the peculiarities of their life and thought. In a large region of Kentucky, Virginia, and North Carolina tobacco is the chief product, and that gives other peculiarities to the country people. And now the tar, pitch, turpentine, and lumber are the important products, especially of North Carolina, Georgia, and Florida, making another type of southern life.

"There is no place that seems further out of the world than the pine forests of Carolina. For half a hundred miles in every direction from this place the wind at night finds nothing to touch it into music but the harps of straw that hang a hundred feet high on millions of pines. This continuous monotone is the most lonely sound that ever reached human ears. It is as depressing as the constant sigh of the melancholy, drooping moss of the live oaks along the Gulf coast. Throughout three or four counties one can frequently ride a distance of ten miles without seeing a house or a living thing. The roads through this region are always deserted in winter. Just at this season, however, one sees the turpentine gatherers at work in the forest. Near the railroad, of course, lumber waggons are seen, and the smoke of turpentine distilleries and saw-mills rises from the pines. The pines monopolize the soil. In these extensive forests there is little other growth except along the streams. There juniper and poplar abound; there too a vigorous undergrowth of smaller trees flourishes. But on the highlands, on all the grounds except the immediate banks of the streams, little undergrowth can be found. So clear are the forests of small trees that one can easily drive a vehicle for miles through the primeval regions without the trouble of making a road.

"No other tree is as variously profitable as the pine. The first money that is made out of it is made by the turpentine men. The tree is boxed, that is, a niche large enough on an old tree to hold half a gallon of deposit is cut into the tree near the ground, and the bark is chipped off for a foot or two above the box. The raw turpentine oozes out in summer, drips down into the box—such quantities of it! On a large tree,

three and sometimes four of these boxes can be cut, between each of which, of course, a small strip of bark is left—enough to keep the tree alive. Early in the summer the tree workers go in the forest. The 'boxers' box the trees, if the field is a virgin forest. Then every week the company of 'hackers' go along and 'hack' every tree a half inch higher, to keep the flow of of the turpentine continuous. This 'hacking' is kept up at the rate of a half inch or an inch a week all summer. This can be continued four or five summers. Then the tree is hacked 5 or 6 feet high, and as a producer of turpentine is valueless. Another company of the tree-workers is the 'dippers,' who whip the resinous deposit from the boxes and put it in barrels that are placed at convenient intervals. Then the raw rosin is carried to the distillery. Thence, of course, it goes to the market as rosin and as spirits of turpentine. The 'virgin' rosin is that which comes from the trees the first summer they are boxed. Nothing can be more beautiful than the virgin rosin when in its liquid form it flows from the distillery and shapes itself into all the fantastic forms of the snow crystals and icicles, and of such wonderfully many tints.

"After the turpentine men have made fortunes from the pines the same trees have other fortunes for the lumbermen. There is more lumber to-day uncut in North Carolina than in all the lumber states of the North-west. A saw-mill here by the railroad is a fortune. The yellow or 'long-leaf' pine attains here its best growth. The trees are branchless for fifty, sometimes for seventy or eighty feet from the ground; and they are all heart. The sap is very thin. When a tree has been drained by the turpentine men for four or five years, the lumber is not as good as that of an unworked tree. But no expert can tell the difference if the tree has not been worked too long." Speaking of the pine knot, the *sine qua non* of Carolina life, he says:—"It even furnishes a medium of communication between different lovers. The lovers sit by the fire, near which fat pine and pine knots are piled in hospitable abundance. The Romeo hands a piece of lightwood to his Juliet, which is to say, 'I pine.' If Juliet is coquettish she returns a knot—'I pine knot;' or she throws his pine in the fire—'I make light of your pine.'

"The men go clad all year long in a texture of cotton and turpentine, and the women go barefoot. They name their chief stream the 'Devil's Gut.' This 'gut,' called Lumber River, is as clear as crystal and never failing, let the rains fall as they may, and is, even in this region, a good water-power.

"A deer hunt reveals the real character of these men. They rise early, ride far and arrange the day's programme with earnestness. As hard in appearance as a pine knot, every one sits on a log at his stand, waiting for the deer, and if a deer

come, he will rarely pass. If by any misadventure one do pass, when that day is done the veterans gather about the offender and swear his excuses into silence. Besides a deer hunt, there is one other occasion that brings the rugged nature to the surface. If fire breaks out among the pines, hundreds of men will emerge from a region where it would hardly seem that dozens dwelt, every one with a spade, a rake, a horn, and an oath. On horseback and on foot they come swiftly from the direction of the wind, and under the leadership of the old deer-hunting commander and ex-confederate, an army of fire-fighters is quickly organized. They form lines of rakemen to clear a space, and then the sand-fingers smother the flames before they can cross.

"Fire-fighting and deer-hunting are but diversions, however. The monotonous life needs quickened influences. They are ignorant in the extreme. Generation after generation have for a hundred years trodden the same paths, and they never seek new ways. Their employment will be the same as now as long as the pine trees last, and a new industry must be depended on to bring an era of any notable innovations.

"The nature of their chief industry does not admit of a dense population, and the region will suffer little change in any way until the pines are exhausted and the people are compelled to devote themselves to agriculture."—*Timber Trades Journal.*

THE following is extracted from the Chief Commissioner's review of the Garo Hills Reports of last year :—

"A Forest Officer was appointed to the district during the year, and the report drawn up by Mr. Fisher, proposing to take up a large number of forest reserves, was laid before the Chief Commissioner, and was generally approved, subject to further enquiry and to the assurance that no rights would be injuriously affected by the operation. In nine cases the Deputy Commissioner has settled the boundaries of the reserves, after making full provision for cultivating and grazing rights; but the reports have not yet been sent up for sanction. A suggestion had been thrown out that *sâl* should be everywhere reserved from felling, as a "royal" tree; but Captain Maxwell shows that this would cause hardship, as the tree grows so generally that no area could be *jhúmed* without felling *sâl*. He proposes, however, that the *sâl* trees thus felled should not be the property of the *jhúmer*, if there is a sale for them. It may, perhaps, be fair to rule that he should have a right to use the timber for his private wants, but not to sell it."

LAC INDUSTRY IN THE PUNJAB.—The trade in lac,—the production of which in Bengal was the subject of a recent article in these columns, is rapidly increasing in the North of

India also. In the Hoshiarpur district of the Punjab, the trade has developed in much the same way as in the Sonthal Pergunnahs. Like the Sonthal Pergunnahs, this district is half mountainous in its character, so the natural conditions may be somewhat similar. The rainfall is about 35 inches; the Palas or Whah tree (*Butea frondosa*) is common; as also the Beri (*Zizyphus Jujuba*), on which latter the lac is most commonly here produced. Other trees on which lac is found in these parts, besides the two above mentioned, are the Pipal, Siris, Banyan, Pilkhan (*Ficus venosa*), Lasura (*Cordia Myxa*), Fig, Phagura (*Ficus caricoides*), Gular (*Ficus Cunia*). The lac produced from the Beri is deemed the best. Next to it come the qualities produced on the Siris, Kikar and Pipal. There are two crops, one in June and the other in October or November. The autumn crop is considered the more valuable.

The artificial preparation of the lac is understood in many villages, but it has not been practised very widely. It seems to be now increasing: it is an extremely simple process, and consists of putting a twig bearing cells of the insect nearly ready to give forth their swarms (or *lakhs* of young ones, for this may be the origin of the name) on the tree on which it is wanted to produce a crop. It is necessary, however, to see that the twig is in close juxtaposition to the branch of the new tree, so that the young ones may readily swarm on to the latter, and for this purpose it is best to wrap the twig round with dry grass or straw before tying it on. There have hitherto been two obstacles to a wider spread of the lac industry in the Hoshiarpur district—one founded on *reason*, the other on *prejudice*. The former relates to the question whether it is worth a zemindar's while to spoil his trees, once or twice a year, by cutting off all the shoots—this is simply a question of price. The prejudice against lac is curious. There used to exist in this district apparently a deep and widespread antipathy among Hindus, against having anything to do with lac. The incrustation was considered a kind of disease or leprosy of the tree, and to be an unclean substance. Its red colour and animal origin are enough to account for this prejudice. It has disappeared to a great extent within the last 12 years, during which the value of lac has risen.

There have been many disputes in the Civil Courts as to the relative rights of landlords and occupancy tenants to the lac produced on the trees of holdings cultivated by tenants. The crop of lac on roadside trees is farmed in their district to a contractor, who is allowed to cut off twigs and branches of a certain thickness. This branch of arboricultural income is being extended, and may become very valuable. Lac propagators are entertained at the proper season, who go along the roads, and put twigs bearing the insect on the trees on which it will thrive. In this manner many a crooked old Beri or

Kikar tree may be made useful. But care requires to be taken to confine the cutting within due limits, else unsightly loppings of big branches are apt to result. The lopping of the branches, unless the tree is a very large one, is a serious matter for the vitality of most trees, but not for the Beri tree. It has a wonderful facility in sending forth, year by year, long, strong, leafy shoots. Hence its great value, in other ways to the zemindar, who lops it for his cattle, and uses its long shoots to hedge his fields or cattle yard.

There are small lac manufactories scattered over the Punjab, for instance, at Nurpur, Adinanagar, Malsian, Hoshiarpur. There is also, we believe, a factory at Delhi. Lac, however, appears to be produced in the Punjab, principally in the sub-mountain districts. It is sparingly produced at Lahore and Amritsar. The coarse lac is brought to the factory by the zemindars or middlemen, who purchase it up and down the country side. It is first crushed and washed. The deposit or sediment left after washing is dried and forms the lac-dye (Rang-batti) of commerce. The clean, broken lac is then put into cotton cloth bags, stuffed into small bolsters as it were, and this bolster is turned slowly over a fire, the lac melting within, oozes through the cloth, and as it exudes spreads outside the bags. When cooled, it forms a pure shining piece of shell lac or *Chapra*, of orange colour.

The lac-dye is used extensively as a dye for wool in Kashmir (the shawl wool is dyed with it); and to some extent in Lahore and Amritsar. It is said that much lac is not produced in Kashmir; that it does not thrive in the neighbourhood of the snows. The manufacture in Hoshiarpur is in the hands of four houses of *Lalkhriahs* who belong to the Khojeh tribe. Shell-lac is exported westward from Hoshiarpur, not eastward. The eastern market is supplied at Mirzapur, Delhi, and other places. But seed-lac, or lac in the raw state, or crushed and washed, (not yet melted) is exported eastward. The trade eastward amounts to many thousand maunds per annum.—*Pioneer*.

Arbor Day in America.—Numbers of pretty groves of trees may be found in all parts of the state, planted both as wind-breaks for the farms, and also for timber plantations. The tree most popular is the cottonwood, which grows very easily, is of certain growth, and very luxuriant in foliage; however, it is valuable for shelter and firewood only, not for manufactures. As an instance of rapidity of growth, there are trees in the Platte valley which, planted as cuttings, have in thirteen years measured 22-inch in diameter. Little boys are tempted by large premiums from their parents to test their capacity at tree planting on Arbor Day, and astonishing rapidity has occasionally been known, one farmer in one day having planted from sunrise to sunset 14,000 trees, and in the

course of one spring over 200,000. Settlers as fast as they arrive aim at accomplishing two things—first, to break the sod for a corn-field; next, to plant timber shelter. The winds which blow from the east are very constant, often fierce, and a shelter is of immense value to stock and fruit trees. Hedges of white willow, several miles in length, have been laid, which at five years from cuttings have made a perfect fence 15 feet high; one farm alone has four miles of such continuous fence, which at four years of age was a complete protection. The rapidity of growth in the rich alluvial soil of the Platte valley impressibly reminds one of tropical luxuriance. A grove of white ash in twelve years has grown to an average of 26-inch in circumference, and 30 feet in height; walnut trees in eight years have measured 22-inch in circumference, and 25 feet in height; maple trees in twelve years measure 43-inch round, 4 feet from the ground; elms of fourteen years show 36-inch in girth, and a foot in diameter; honey locusts eleven years of age are 30 feet high, and 30-inch in circumference; cotton-wood trees of thirteen years' standing have reached 66-inch in circumference, and 22-inch in diameter; white willow of the same age, 45-inch in circumference.

Such indeed is the fertility of this soil, the growth of wood being almost unequalled in any quarter of the globe.—*Timber Trades Journal.*

It is recorded in the *Revue des Eaux et Forêts* that a forest guard, named Beny, has pointed out a good plan of getting rid of cockchafer grubs from his garden. He digs holes about 2 feet in diameter and 2 feet deep, and fills them with stable litter covered over with soil.

In June, in a day when the sun is hot, the holes are opened, and a large number of grubs are then found and destroyed. But such a measure would be of very little use in India. In 1881 in Darjeeling almost all gardens were visited by these cockchafer grubs, who eat off not only the roots of bulbs and other flowering plants, but stripped the turf from the banks. The Superintendent of the Botanic Garden made an estimate that he had destroyed about eight millions of them. This year the beetle is not uncommon, and it is much to be hoped that it will take itself off elsewhere to lay its eggs.

We hear that Col. G. F. Pearson has been allowed leave, and that Col. Seaton, the Conservator of Forests in Tenasserim, is officiating for him at Nancy.

Mahogany.—We quote the following from the *Building News*:—There is perhaps no wood with which we are acquainted of which so many varieties are known as that we term mahogany, or bay wood. The mahogany first introduced, and

used mainly for cabinet work, was the dark, dense timber termed "Spanish mahogany," chiefly imported from San Domingo. From this source for many years all the best logs were obtained, and the fine old furniture of the Georgian period was almost all made of the San Domingo wood. As soon as this supply fell short, other islands in the Antilles and the mainland of the isthmus were explored, and quantities of excellent wood were obtained from them. The wood from the central region of Mexico, and from the island of Cuba, was but little inferior to the best qualities from St. Domingo, and from the regions farther south, in Honduras, British and Dutch Guiana, logs of more fully-grown timber and of vast size were obtained. The lighter open grained wood, termed "baywood" or "Honduras," which in its best form may even approach the quality of the Spanish mahogany, but which chiefly approximates more nearly the texture of cedar, is now much used for joiners' work. The finest old Spanish wood is so scarce and valuable that the bulk of it is probably cut up for veneers. The Cuba wood, which takes the place of that formerly brought from San Domingo, is mostly small. It comes over in sticks rather than in logs, seldom exceeding 2 feet square, and is liable to be "stainy" or streaked with purple. Some of the Central American timber from the interior of Mexico is very dense and rich in colour, and perhaps rivals that from Cuba.

All mahogany darkens in colour on exposure to the atmosphere, but it is a favourite trick to stain the lighter varieties with an alkaline wash in order to give them a darker tone. Few woods stand wear and tear better in cabinet work than fine mahogany, and the bright rich tints are found in no other wood with which we are familiar. It seems probable that all the mahogany timber to which we have alluded is the produce of the same tree, the *Swietenia Mahogani* of botanists, so called after Van Swieten, a Dutch physician, but evidence on this point is rather confusing. The value of mahogany fluctuates greatly, and the purchase of this timber is said to be always somewhat of a lottery. Buyers test the quality by boring into the log with an auger, but this plan is liable to mislead. There is a sort of tradition, the truth of which it is difficult to test, that Messrs. Broadwood once gave £3,000 for three logs of mahogany, all of them cut from one tree. Each balk was 15 feet in length, and 3 feet 2 inches square. This would give 451 cubic feet, and a price of £6 13*s.* per cubic foot! In some other accounts of this transaction the price named is £2,000, which, if correct, would represent £5 9*s.* per cubic foot. The cause of this extraordinary price is said to have been the extreme beauty of the "curl," or figure of the wood which rendered it suitable for the production of veneers. Strange to say, this high-priced mahogany was imported from Honduras, and it seems probable that while the northern district of the country

bordering on Mexico produces dense and fine qualities of timber, the wood grown in the low, swampy districts to the southward has given a bad name to the mahogany of the whole district.

In an interesting paper, read at the Society of Arts, by Mr. Leonard Wray, in 1859, on "Timber for Ship-building," printed in Vol. VII. of the Society's "Transactions," an account is given of the cutting down and preparation of this wood for sale, and, as touching the density of the best Northern Honduras mahogany, we read that its specific gravity equals that of the finest Travancore teak, and is superior to English oak. The difficulties in felling the wood in the trackless forests and bringing it to Belize for sale appear to be immense, and all the labour has to be done at night by torchlight, owing to the intense heat.

Mr. Wray, in the paper before alluded to, states that mahogany is only classed in the second rate at Lloyds' among the timbers for ship-building purposes. While eight varieties of wood are ranked in the first division, we find mahogany included among the twenty species of timber placed in the second class, the reason being that fine, dense mahogany is too costly and good for the purpose, while the cheaper baywood, the price of which would enable it to be used, comes only in the second division. The mahogany of Hispaniola is said to have been used by Raleigh for the repair of one of his ships in 1595; and a Spanish line-of-battle ship, built at Havannah, of the finest picked timber, when captured by the English and broken up, more than one hundred years after she had been launched, was found to have every timber sound. The Queen's own steam yacht, the *Victoria and Albert*, is built of mahogany.

VI. Extracts from Official Gazettes.

1.—Gazette of India—

No. 252F.—31*st March* 1882.—*Mr. A. E. Lowrie*, Probationer in the Forest Department of the North-Western Provinces and Oudh, is appointed a Sub-Assistant Conservator of Forests, with effect from the 6th January 1882.

Mr. Lowrie will continue for the present to be employed in the North-Western Provinces and Oudh.

No. 258F.—4*th April* 1882.—The following officers, who have been appointed by Her Majesty's Secretary of State to the Forest Department of India, are appointed Assistant Conservators of Forests of the 3rd Grade, with effect from the dates specified opposite their names, and are attached to the Provinces mentioned below :—

Mr. M. H. Clifford ...	North Western Provinces and Oudh.	...	4th October 1881
Mr. J. H. Lace	Punjab	...	31st December „
„ E. S. Carr	„	...	30th „ „
„ F. S. Barker ...	Assam	...	31st January 1882
„ A. G. Hobert-Hampden	North Western Provinces and Oudh	...	2nd „ „
„ C. A. G. Lillingston	Bengal	...	23rd February „

Mr. Clifford will be employed in Europe on special duty for one year.

No. 316F.—19*th April* 1882.—*Mahomed Anwar Khan*, Sub-Assistant Conservator of Forests in Ajmere, is transferred to the Central Provinces.

No. 333F.—21*st April* 1882.—*Mr. W. H. Reynolds*, Deputy Superintendent of Forest Surveys, is granted privilege leave of absence for three months, with effect from the 15th instant, or any subsequent date on which he may avail himself of it.

Mr. E. F. Litchfield, Assistant Conservator of Forests, 2nd Grade, attached to the Forest Survey Branch, is appointed to officiate as Deputy Superintendent of Forest Surveys, during the absence, on leave, of *Mr. Reynolds*, or until further orders.

No. 370F.—29*th April* 1882.—*Major F. Bailey, R.E.*, temporarily appointed by the Notification of this Department No. 927F., dated the 11th October last, to be Officiating Conservator of Forests in the Punjab, will revert to his substantive appointment of Conservator of Forests of the School Circle in the North-Western Provinces, and Director of the Forest School.

Major G J. VanSomeren, Officiating Conservator of Forests of the School Circle in the North-Western Provinces, and Director of the Forest School, is appointed, as a temporary arrangement, to officiate as Conservator of Forests in the Punjab.

No 384F.—*8th May* 1882 —*Mr. D Brandis, C I.E.*, Inspector-General of Forests to the Government of India, on special duty, is granted privilege leave of absence for three months, with effect from the 10th instant, or any subsequent date on which he may avail himself of it.

No. 392F.—*11th May* 1882.—*Mr. E Ludlow*, Assistant Conservator of Forests of the 1st Grade in the Central Provinces, is transferred to Assam

No. 440F —*26th May* 1882.—*Mr. D P. Copeland*, Sub-Assistant Conservator of Forests in Assam, is appointed to officiate, until further orders, as an Assistant Conservator of Forests of the 3rd Grade, with effect from the 1st May 1882.

No. 476F.—*6th June* 1882.—*Mr. J. C. Murray*, Sub-Assistant Conservator of Forests in the North-Western Provinces, is appointed to officiate, until further orders, as an Assistant Conservator of Forests of the 3rd Grade, with effect from the 26th May 1882.

No 319 (*Military*).—*9th June* 1882 —The undermentioned officer is granted furlough out of India, with the necessary subsidiary leave:—

Captain C. T. Bingham, Bengal S C, Deputy Conservator of Forests, 2nd Grade, British Burma, (p a) for two years, under Rule IX of the Regulations of 1868.

No. 511F.—*14th June* 1882 —The Notification of this Department, No. 384F., dated the 8th ultimo, granting three months' privilege leave of absence to *Mr. D. Brandis, C I.E*, Inspector-General of Forests to the Government of India, on special duty, is hereby cancelled.

No. 521F.—*16th June* 1882 —*Mr. B. A. Rebsch*, Sub-Assistant Conservator of Forests in Oudh, is appointed to officiate, until further orders, as an Assistant Conservator of Forests of the 3rd Grade, with effect from the 1st June 1882

No. 534F.—*21st June* 1882.—*Mr. W. E. D'Arcy*, Assistant Conservator of Forests of the 1st Grade in Assam, is transferred to the Hyderabad Assigned Districts.

2.—CALCUTTA GAZETTE—

22nd May 1882.—*Mr W. F. Hobson*, late Sub-Assistant Conservator of Forests, Chittagong Forest Division, was allowed privilege leave under chapter X, section 136 of the Civil Leave Code, from the 1st to the 14th February 1882.

13th June 1882.—*Mr. G. A. Richardson*, Assistant Conservator of Forests, Buxa Division and *Mr. R. L Heinig*, Sub-Assistant Conservator of Forests, Julpigori Forest Division, are deputed to attend the course of instruction for two months or more at the Central Forest School at Dehra Dun, North-Western Provinces, which is to commence on the 1st July next.

Mr. H. H. Davis, Deputy Conservator of Forests, at present in charge of forest inspection in Orissa, is appointed to officiate in charge of the Buxa Forest Division, during the absence of *Mr. Richardson*, from the date on which he may relieve that officer.

During the absence of *Mr. Heinig*, the Conservator of Forests, Bengal, will take charge of the Julpigori Forest Division, in addition to his own duties, from the date on which he may relieve *Mr. Heinig*.

3.—NORTH-WESTERN PROVINCES GAZETTE—

No. 158.—12*th April* 1882.—With reference to the Notification by the Government of India in the Home Department (Forests), No. 258F., dated 4th April 1882, republished in the *Punjab Government Gazette* of the 13th idem, *Mr. J. H. Lace*, Assistant Conservator of Forests, is posted to the Gujranwala Division, with effect from the afternoon of the 30th December 1881; and *Mr. C. S. Carr*, Assistant Conservator, to the Lahore Division, with effect from the afternoon of the 29th idem.

No. 241.—12*th April* 1882.—In continuation of Notification No. 131, dated 3rd March 1882, *Mr. N. Hearle*, Assistant Conservator of Forests, to the charge of the Jaunsar Division of the School Circle, during the absence, on furlough, of *Mr. A. Smythies*, or until further orders.

No. 285.—22*nd April* 1882.—The untaken portion, *viz.*, 68 days, of the privilege leave granted to *Dr. H. Warth*, Instructor, Central Forest School, Dehra Dun, by Notification No. 107, dated 28th February last, is hereby cancelled.

No. 327.—17*th May* 1882.—*Mr. A. G. Hobart-Hampden*, Assistant Conservator of Forests, 3rd Grade, attached to the Dehra Dun Division of the School Circle, three months' examination leave, to enable him to study Hindustani, from the 1st July 1882, or date on which he may avail himself of it.

No. 350.—20*th May* 1882.—*Mr. O. Greig*, Assistant Conservator of Forests in charge of the Garhwal Division of the Central Circle, is granted leave to Europe on medical certificate from the 26th May to the 10th November 1882, with the usual subsidiary leave.

No. 358.—23*rd May* 1882.—*Mr. A. F. Broun*, Assistant Conservator of Forests (attached to the Dehra Dun Division of the School Circle), is promoted from the 3rd to the 2nd Grade, with effect from the 5th January 1882.

No. 372.—29*th May* 1882.—In continuation of Notification No. 350, dated 20th May 1882, *Mr. I. E. O'Callaghan* Deputy Conservator of Forests, Kumaun Division, Central Circle, to the charge of the Garhwal Division in that circle in addition to his other duties, during the absence on leave of *Mr. O. Greig*, or until further orders.

4.—PUNJAB GAZETTE—

No. 162.—14*th April* 1882.—With the sanction of the Government of India, *Mr. R. H. C. Spread* is permitted to resign his appointment as a Probationer in the Forest Department of the Punjab, with effect from the 28th February 1882.

No. 170.—20*th April* 1882.—*Mr. E. Forrest*, Assistant Conservator of Forests, reported his arrival at Bombay on the 28th March 1882, on return from furlough to Europe. *Mr. Forrest* is attached temporarily to the Direction Division, which he joined on the forenoon of the 6th April 1882.

No. 188.—11*th May* 1882.—Under the provisions of section 34 of the Indian Forest Act, 1878, *Mr. E B. Steedman*, Settlement Officer, Rawalpindi District, is appointed Forest Settlement Officer for the purpose of enquiring into, settling, defining and recording the grazing rights existing in favour of Pir Sadr-ud-din of Patta Hotar, within the limits of the Rakh Margalla declared a reserved forest by *Punjab Government Gazette* Notification, No. 95F., dated 1st March 1879. And under the provisions of section 16 of the aforesaid Act, the Hon'ble the Lieutenant-Governor is pleased to appoint *Major E. G. Wace*, Settlement Commissioner, Punjab, to hear appeals from the orders of *Mr. E. B. Steedman*, in the said case.

No. 207.—22*nd May* 1882.—With reference to Notification by the Government of India in the Home Department, No. 370F., dated 29th April 1882, republished in Part II. of the *Punjab Government Gazette* of the 11th May 1882, *Major G. J. VanSomeren* assumed charge of the duties of Conservator of Forests, Punjab, on the afternoon of the 10th May 1882, relieving *Major F. Bailey, R.E.*

No. 232.—1*st June* 1882.—In modification of Notification No. 400F., dated 6th November 1878, the Hon'ble the Lieutenant-Governor is pleased to declare that in cases where the value of a contract or other instrument in matters connected with the administration of forests and the business of the Forest Department exceeds Rs. 10,000, the said contract or other instrument shall be executed either by the Secretary to the Local Government in the Civil Department, or by the Junior Secretary in that Department, as may be most convenient in each case.

5.—CENTRAL PROVINCES GAZETTE—

No. 1438.—28*th April* 1882.—*Mr. E. Ludlow*, Assistant Conservator of Forests, 1st Grade, is transferred from the Bhandara District to the Direction Division, which he joined on the afternoon of the 21st instant.

No. 1516.—4*th May* 1882.—*Mr. R. H. E. Thompson*, Deputy Conservator of Forests, availed himself on the forenoon of the 13th April 1882 of the three months' privilege leave granted to him by Notification No. 1060 of 29th March 1882.

No. 1828—26*th May* 1882—One year's furlough, under section 49 of the Civil Service Code, is granted to *Mr. R. H. C. Whittall*, Deputy Conservator of Forests, Nimar Division, with effect from 1st July next, or the subsequent date on which he may be relieved of his duties.

No. 2018.—10*th June* 1882—*Mr E Ludlow*, Assistant Conservator of Forests, 1st Grade, transferred to Assam by Government of India Notification No. 392F. of the 11th ultimo, was relieved of his duties in these Provinces on the afternoon of the 22nd idem.

No. 2276.—26*th June* 1882.—*Mr. G. Taylor*, Officiating Assistant Conservator of Forests, attached to the Chanda Division, is posted to the charge of the Saugor Division.

Mr. G. Foster, Officiating Deputy Conservator of Forests, on being relieved by *Mr. Taylor*, is transferred to the charge of the Nimar Division.

6.—British Burma Gazette—

No. 47.—25*th May* 1882.—*Mr. C. W. Palmer*, Officiating Deputy Conservator of Forests, reported his return from the privilege leave granted to him in this Department Notification No. 32, dated the 21st March 1882, on the afternoon of the 22nd May. The unexpired portion of his leave is hereby cancelled.

No. 48.—*Mr. C. W. Palmer*, Officiating Deputy Conservator of Forests, is placed on special duty, with effect from the 23rd May 1882.

No. 206.—8*th June* 1882—At the Departmental Examinations held in Rangoon on the 5th and 6th June 1882, under this Department Notification No. 510, dated the 1st December 1880, the following candidates passed in Burmese by the standards mentioned:—

Higher Standard.

Mr. F. W. Thellusson, Assistant Conservator of Forests.

Lower Standard.

Mr. T. A. Hauxwell, Assistant Conservator of Forests.

No. 50.—12*th June* 1882.—*Mr. C. W. Palmer*, Officiating Deputy Conservator of Forests, reported his return on the 7th June from the special duty on which he was employed, and is permitted to avail himself, with effect from that date, of the unexpired portion of the privilege leave granted him in this Department Notification No. 32, dated the 21st March 1882.

No. 56—26*th June* 1882.—Under the provisions of sections 71 and 73 of the Civil Leave Code, *Mr. F. W. Thellusson*, Assistant Conservator of Forests, 1st Grade, is granted privilege leave for three months from the 24th instant, or the date on which he may avail himself of it.

No. 57.—26*th June* 1882.—*Mr. F. W. Thellusson*, Assistant Conservator of Forests, returned to duty on the forenoon of the 31st ultimo from the examination leave granted to him in Notification No. 34, dated the 30th March last.

No. 52.—*The 29th June* 1882.—*Mr. F. W. Thellusson*, Assistant Conservator of Forests, 2nd Grade, is promoted to be an Assistant Conservator of Forests, 1st Grade, with effect from the 15th June 1882.

No. 53.—*Mr. T. A. Hauxwell*, Assistant Conservator of Forests, 3rd Grade, is promoted to be an Assistant Conservator of Forests, 2nd Grade, with effect from the 9th June 1882.

No. 54.—*29th June* 1882.—*Mr. J. Nisbet*, Officiating Deputy Conservator of Forests, received charge of the Western Forest Division, Pegu Circle, from *Mr. C. W. Palmer*, on the afternoon of the 28th April 1882, on which date *Mr. Palmer* availed himself of the leave granted to him in this Department Notification No. 32, dated the 21st March 1882.

No. 55—*Mr. J. Nisbet*, Officiating Deputy Conservator of Forests, received charge of the Rangoon Forest Division from *Mr. P. J. Carter* on the forenoon of the 8th May 1882, on which date *Mr. Carter* availed himself of the leave subsidiary to the special leave granted to him in this Department Notification No. 33, dated the 23rd March 1882.

7.—ASSAM GAZETTE—

No. 10.—*27th April* 1882.—Under section 51 of Act VII. of 1878 (The Indian Forest Act) the Chief Commissioner is pleased to make the following rules relating to the collection of drift and stranded timber in the district of Cachar:—

I. No timber or bamboos found adrift, stranded, or sunk in any of the rivers in the district of Cachar, shall be moved to, or landed at, any places other than such as may from time to time be notified by the District Forest Officer as depôts for the reception of drift timber.

II. Salvage will be paid for all timber and bamboos collected in such depôts at the following rates:—

	Rs.	A.	P.
1. For every raft containing more than five logs ...	5	0	0
2. For every log in any raft containing not more than five logs	1	0	0
3. For every single log from 5 to 10 feet in length, and from 2 to 4 feet in girth	0	8	0
4. For every single log over 10 feet in length and over 4 feet in girth	1	0	0
5. For every raft of bamboos, 10 per cent. on the valuation made by the District Forest Officer or any other Officer authorised on his behalf	0	0	0

III. No such timber nor bamboos shall be delivered until after the receipt of the sum paid as salvage money, together with any other expenses incurred on that account, nor be sold otherwise than by public auction or at such rates as may be sanctioned by the Conservator of Forests, Assam.

IV. All timber found adrift, beached, stranded, or sunk in any river of the district of Cachar measuring less than 5 feet in length and 2 feet in girth, except Jarul, Nageswar, and Gandrai timber, is hereby exempted from the provisions of section 45 of the Indian Forest Act, 1878.

V. Any person infringing any provision of these rules shall be punished with rigorous or simple imprisonment for a term which may extend to six months, or with fine, which may extend to five hundred rupees, or with both.

No. 11.—*9th May* 1882.—The Chief Commissioner hereby declares that the forest land within the boundaries mentioned below, which forms a portion of that appropriated for Government purposes in the neighbourhood of Kohima, in the Naga Hills district, in April 1880, is reserved for the growth of timber.

Jhuming within these boundaries is strictly prohibited. No cutting or removal of timber or firewood within these boundaries will be permitted except on proper authority from the Deputy Commissioner.

Boundaries.

From a round hill shown as Station G in the Kohima Survey Plan, first a line bearing 268 deg, second a line bearing 160 deg., and the arc of the Polyvadzu ridge intersected between these two lines.

Lines will be cut through the forest, marking these boundaries, and mounds erected at the points where the lines intersect the arc of the Polyvadzu ridge.

No. 123.—*12th May* 1882.—*Mr. F. S. Barker*, Assistant Conservator of Forests, Lakhimpur, is transferred to the district of Darrang, during the absence, on deputation, of *Mr. T. J. Campbell*, Sub-Assistant Conservator, or until further orders.

No. 157.—*15th June* 1882.—Privilege leave for three months, with effect from the 26th June or the subsequent date on which he may avail himself of it, is granted to *Mr. J. T. Jellicoe*, Officiating Deputy Conservator of Forests, Goalpara Division.

No. 166.—*28th June* 1882.—*Mr. T. J. Campbell*, Sub-Assistant Conservator of Forests, made over charge of the Darrang and Nowgong Forest Divisions to *Mr. F. S. Barker*, Assistant Conservator of Forests, 3rd Grade, on the afternoon of the 8th June 1882.

No. 168.—*28th June* 1882.—*Mr. E. Ludlow*, Assistant Conservator of Forests, 1st Grade, on transfer from the Central Provinces, reported his arrival and assumed charge of his duties in the office of the Conservator of Forests, Assam, on the 20th June 1882.

8.—BOMBAY GAZETTE—

No. 2346.—*10th April* 1882.—His Excellency the Governor in Council is pleased to appoint *Mr. W. S. Hexton*, Deputy Conservator of Forests, 2nd Grade, Kanara, to act as Conservator of Forests in Sind during the absence of *Major McRae*, on furlough, or till further orders.

12th April 1882.—*Messrs. J. M. Fernandez* and *M. D'Cruz*, respectively delivered over and received charge of the office of the Sub-Assistant Conservator of Forests, Northern Division of Kanara, Karwar, on the 4th April 1882, before office hours.

No. 2434.—13*th April* 1882.—His Excellency the Governor in Council is pleased to appoint *Mr. M. D'Cruz*, Officiating 1st Grade Sub-Assistant Conservator of Forests, Kanara, to act as 3rd Grade Assistant Conservator of Forests, and *Mr. J. M. Fernandez* to act as 3rd Grade Sub-Assistant Conservator in the Southern Division, during the absence of *Mr. W. S. Hexton*, or till further orders.

20*th April* 1882.—*Messrs. W. S. Hexton* and *W. A. Talbot* respectively delivered over and received charge of the office of the Deputy Conservator of Forests, Northern Division of Kanara, on the 15th April 1882, after office hours.

2*nd May* 1882.—*Messrs. W. A. Talbot* and *M. D'Cruz* respectively delivered over and received charge of the office of the Deputy Conservator of Forests, Northern Division of Kanara, on the 24th April 1882, before office hours.

8*th May* 1882.—*Mr. A. D. Wilkins*, District Forest Officer, received charge of the duties of District Forest Officer, South Thana, comprising the Murbad, Kalyan, Karjat, and Panvel Talukas of the Thana District, in addition to the Alibag and Pen Talukas of Kolaba District, from *Mr. G. K. Betham*, District Forest Officer, Thana, on the 29th April 1882.

9*th May* 1882.—*Mr. Wamon Ramchandra Gaundé*, Acting Sub-Assistant Conservator of Forests, received charge of the District Forest Office, Ratnagiri, from *Mr. S. Hornidge*, District Forest Officer, Ratnagiri, on the 26th April 1882, after office hours.

No. 3069.—10*th May* 1882.—*Mr. Narayan Ballal Oke*, Sub-Assistant Conservator of Forests, 1st Grade, has been allowed privilege leave of absence for two months and twenty-five days from the 24th February 1882.

11*th May* 1882.—*Mr. S. Hornidge, A.M.I.C.E.*, Acting Assistant Conservator of Forests, 3rd Grade, delivered over to *Mr. Wamon Ramchandra Gaundé*, Acting Sub-Assistant Conservator of Forests, Southern Division, charge of the District Forest Office, Ratnagiri, on the 26th April 1882, after office hours.

12*th May* 1882.—*Mr. Robert Ryan*, who was appointed in Government Resolution No. 2083 of the 30th March 1882, to act as Assistant Conservator of Forests, 3rd Grade, reported himself for duty to the Deputy Conservator of Forests, Belgaum, on the 17th April 1882, after office hours.

17*th May* 1882.—*Mr. J. M. Fernandez* relinquished charge of the office of the Sub-Assistant Conservator of Forests, Southern Division of Kanara, on the 5th May 1882, after office hours, and *Mr. Shesho Munjo*, Forest Ranger of Sirsi Taluka, received charge of the said office on the 6th idem, before office hours.

18*th May* 1882.—*Messrs. G. Waddington*, Collector of Sholapur, and *S. Hornidge, A.M.I.C.E.*, Acting Assistant Conservator of Forests, 3rd Grade, respectively delivered over and received charge of the Sholapur District Forest Office on the 29th April 1882, forenoon.

19*th May* 1882—*Messrs. M. D'Cruz* and *J. M. Fernandez* respectively delivered over and received charge of the office of the Sub-Assistant Conservator of Forests, Northern Division of Kanara, on the 10th May 1882, before office hours.

No. 3306—20*th May* 1882—*Mr. A. D. Wilkins*, Assistant Conservator of Forests, South Thana Forest District, passed on the 3rd ultimo the examination prescribed in rule 6 of the rules published in Government Notification No. 2878, dated 4th June 1882, for the examination of Forest Officers.

5*th June* 1882.—*Mr. Annaji Venkatrao*, Sub-Assistant Conservator of Forests, Kaladgi, who was grantde privilege leave for one month in Government Resolution No. 2940 of 5th May 1882, delivered over charge of his office to *Mr. Gopal Swamirao*, Range Forester of Bagalkot Taluka, on the 22nd May 1882, before office hours.

7*th June* 1882.—*Mr. Ganesh Krishna Shahane*, Sub-Assistant Conservator of Forests, 3rd Grade, Thana, delivered over charge of his office to *Mr. Betham*, District Forest Officer, North Thana, on the 25th May 1882, after office hours.

No. 3994.—21*st June* 1882—*Mr. Annaji Venkatrao*, Sub-Assistant Conservator of Forests, Kaladgi, is allowed privilege leave of absence for one month, with effect from the 22nd May 1882.

No. 4210.—30*th June* 1882.—*Mr. J. M. Fernandez* acted as Sub-Assistant Conservator of Forests, 3rd Grade, from the 4th to the 12th April 1882, *vice Mr. Menezes* on sick leave.

Mr. Shesho Manjir to act as Sub-Assistant Conservator of Forests, 3rd Grade, with effect from the date of his taking charge, during the absence of *Mr. Menezes* on sick leave, or until further orders.

9.—Mysore Gazette—

No. 33.—12*th May* 1882.—The following promotions are ordered from the first April 1882:—

Mr. E. P. Lovery, to be Assistant Conservator of Forests on the Local Establishment, on Rs. 200 per month.

Mr. T. Abdul Karim, to be Assistant Conservator of Forests on the Local Establishment, on Rs. 200 per month.

Probationer *Narayan Rao*, to be Sub-Assistant Conservator of Forests on the Local Establishment, on Rs. 150 per month.

Probationer *Mr. Stephens*, to be Sub-Assistant Conservator of Forests on the Local Establishment, on Rs. 150 per month.

[We regret that, as we do not receive the *Madras or Sind Gazettes*, we are unable to give notifications from these Provinces]

THE

INDIAN FORESTER.

Vol. VIII.] OCTOBER 1882. [No. 2.

To our Readers.

In announcing the fact of the transfer of the Editorship of the "Indian Forester" from Mr. Gamble to Mr. W. R. Fisher, of the Dehra Dun Forest School, we solicit the continued support of forest officers and of the general public. All our readers must feel grateful to Mr. Gamble for the great pains which he has taken as Editor since he assumed charge from Dr. Schlich in October 1878, and we are glad to say that he has kindly promised his assistance for the future as a regular contributor.

It is now proposed to complete Volume VIII of the quarterly series by publishing the part for January in December, with a double number of pages, and to commence a new series in monthly parts from the 1st of January 1883. In this we have the approval of the former Editors, Dr. Schlich and Mr. Gamble.

The scope of the "Indian Forester" will be the same as that sketched by Mr. Baden-Powell and Dr. Schlich in the opening prologue of Volume I, except that Horticulture will be added to the list of subjects treated of, as all will doubtless agree that a neat garden and a well-stocked orchard are the best ornaments of a forester's compound, and that a good horticulturist will be a good nurseryman. Mr. Gollan, of the Saharanpur Botanic Garden, has kindly promised to contribute monthly papers on horticulture, and to answer any queries sent by our subscribers regarding the cultivation of ornamental plants and fruit trees.

Foresters in India and elsewhere spend a great deal of their time in the open air, and have, therefore, splendid opportunities for observing facts of Natural History; and they frequently meet with adventures which are interesting to all lovers of shikar. Contributions under these heads are always acceptable, and should be sent direct to Mr. R. H. E. Thompson, of the Central Provinces, who, for the future, will conduct the Department of this magazine devoted to Natural History, Shikar, and Travel, and has also offered to assist in identifying any insects, birds, snakes or mammals, which may be sent to him. With his assistance, and that kindly promised

by Mr. Duthie, Superintendent of the Saharanpur Botanical Garden, we hope to be able to name plants, and will gladly undertake to do so, provided as complete botanic specimens as are available be supplied.

For all questions of forest law, we still count on Mr. Baden-Powell's assistance, and will refer any questions asked by our subscribers, for his advice and remarks.

Mr. Fernandez of the Working Plan's Branch, now attached to the Forest School Circle, has special opportunities for studying the nature and growth of forest plants in the different provinces of India, and has kindly promised to deal with questions of Vegetable Physiology and Sylviculture.

Dr. Warth, also of the Forest School, has promised to contribute and to superintend the publication of papers relating to Physics, Rocks, Minerals, Soils, or Climatology, and with the help of the school laboratory and museum he hopes soon to be in a position to analyse soils and determine minerals and rocks sent to him by our subscribers.

The Editor, besides the general management of the Magazine, will receive all papers concerning forest organization, and the utilization of forest produce, and others of a general nature; and he would here express his thanks for the support offered by Government to the "INDIAN FORESTER" in the supply of important papers, gazettes, and in other respects.

It will be a matter of convenience if contributors will kindly send papers under any of the heads above sketched direct to the gentlemen who have undertaken charge of them, and we have every confidence that this division of the labours of editorship will prove advantageous. Contributions of all kinds will also be received by the Editor, Forest School, Dehra Dun.

The conversion of the "INDIAN FORESTER" from a quarterly to a monthly publication has been determined on with the object of rendering it somewhat more inviting to correspondents, who probably desire speedy replies to their enquiries, and are apt to lose interest in matters which can only be discussed at intervals of three months; and the extra labor involved will be amply repaid if the facilities thus afforded for recording and interchanging experience are freely utilized.

If each divisional forest officer in India would communicate to us any matter of general interest which may occur from time to time in his division, the usefulness of our Magazine would be greatly increased.

Besides the greater interest which we hope that under the above arrangements our correspondence columns will afford, we can promise our readers that several important original works and translations will appear in monthly parts in the new series.

In return for the more frequent appearance of the "INDIAN

FORESTER," we appeal to the *esprit de corps* of all members of the controlling and executive staff of the Forest Department in India, and especially to those who may receive their professional training at the Dehra Dun Forest School. We regret to say that at present only 43 per cent. of the officers of the superior staff, and only a very few Forest Rangers, are on our lists of subscribers, but we hope that matters may speedily improve in this respect.

Besides our appeal to forest officers, we claim the support of district officers, land-owners, planters, and all who are interested in the relations between Man and Nature.

The importance of forest conservancy, in preserving as much of wild nature as is essential for the comfort and necessities of an increasing population, is recognized on all hands; and the question of timber and fuel supply, the selection and planting of trees along the road sides and in groves, and the preservation and extension of natural pastures, are matters of general and pressing interest. The only rules yet made for preserving game birds and protecting fish in their breeding season, and their fry on their way down to the larger rivers, are, we believe, those made in our reserved forests; and all such efforts to prevent waste and destruction will meet with attention and sympathy in our pages. Our principal object is, however, both by independent research and by reviewing the progress made in other countries, to further and aid the study of forestry in India, so that it may take its place amongst the other arts which have become completely naturalized in the country, and this can never be realized without the sympathy and co-operation of all those entrusted with the control of the Indian Forests.

Notes for a Manual of Sylviculture.

THE following pages are extracted from the rough draft, as it now stands, of BOOK II of the MANUAL OF INDIAN SYLVICULTURE, which is in course of preparation. They are published here, as they deal with subjects which ought evidently to be discussed as widely as possible before the Manual takes its final shape.

Forestry in India is an art of very recent growth, while in the United Kingdom there is not only no uniform set of technical terms in general use, but, moreover, owing to the fact that forest management on a large scale has, for obvious reasons, never yet formed an essential part of the State economy, several important ideas, which to the continental forester are every-day commonplaces, have not received their expression except in seldom-used clumsy periphrases. In drawing up our technical vocabulary we have hence considered ourselves completely unfettered by present practice, save in so far

that we have felt ourselves bound to accept current words that are logical equivalents of the ideas for which they stand. For instance, there was no reason to exclude the terms *stock, crop, stool, copse,* &c. Then, again, the expressions *high forest, regeneration, rotation,* and several others, which, although foreign to purely English ears, are nevertheless recognised in India, have been retained without any qualification. Whereas, instead of the current term *coppice-shoot,* we have adopted *stool-shoot,* which the shoot meant really is. A copse may, as we all know, be composed wholly or partly of root-suckers, and the former word would also logically include these shoots from the roots. To give one more instance: Instead of the expression *water-shoots,* which at the best is extremely unscientific and misleading, we have coined the word *epicorm* (Επῖ, *upon,* and Κορμος *a stem*).

The most crucial test of a good *lingua technica* is that it should be at once intelligible, and at the same time in sympathy with the spirit of the vernacular to which it belongs. The moment for submitting our technology to the criticism of the public in general, and of foresters, British as well as Indian, in particular, would have arrived when the entire Manual was in print. But in the present case we are met at the very outset with this difficulty, that year after year a certain number of Indian forest officers and subordinates are trained at the Central Forest School at Dehra Dun, and for their course of instruction we must have a complete set of technical terms that have received the sanction of foresters working in every part of the world where English is spoken. To wait until the publication of the Manual would be to teach in the meantime a vocabulary, which must soon after be unlearnt.

The technical terms, with their definitions, which are now given, are only such as occur in Chapter II of the Manual which immediately follows. The rest will be published in some future number of the INDIAN FORESTER.

The Chapter of the Manual just alluded to is the very first attempt hitherto made to describe in detail, although in as brief a manner as possible, the *struggle for existence* between the various plants composing a forest crop. Why certain species should predominate at a given age, why these or others should maintain themselves in the crop, while the rest are gradually driven out or left completely in the minority later on, is the first question which the forester ought to be able to answer, especially in India, where sometimes more than 100 different species of trees and shrubs grow together within the limits of a single square mile. And it is on account of this very variety of species, and the great diversity of the effective factors of soil and climate that the task of answering it satisfactorily is extremely difficult, and certainly impossible for a single

individual, without the active and sympathetic co-operation of foresters in the several provinces and districts of India.

The "INDIAN FORESTER" is soon to become a monthly journal, and it is earnestly hoped that its more frequent issue will induce its readers to criticise freely the following extract from the Manual of Indian Sylviculture, and offer us the benefit of their special experiences. The Manual is intended for all the territories under the jurisdiction of the Viceroy of India, and illustrations of general principles from districts outside the range of our observation are invited, and will supply many unavoidable and regrettable omissions.

BOOK II.—INDIAN SYLVICULTURE.

PART I.—GENERAL.

CHAPTER I.—*Preliminary Definitions.*

A TREE is any woody plant branching from a certain height above the ground, and capable of attaining a minimum height of 25 feet. The term "tree" includes arborescent palms and bamboos.

Trees may be classed as follows:—

(*i.*) LARGE trees, those which can attain a height of over 80 feet, *e.g.* teak, sal, deodar, &c.

(*ii.*) MIDDLE-SIZED trees, those which attain a height of between 50 and 80 feet, *e.g.* sissoo, *Anogeissus latifolia*, babul, *Quercus semecarpifolia*, *Quercus incana*, toon, &c.

(*iii.*) SMALL trees, those which attain a height of from 25 to 50 feet, *e.g.* *Ougeinia dalbergioides*, khair, *Anogeissus pendula*, *Butea frondosa*, &c.

A SHRUB is a woody plant incapable of attaining a greater height than 25 feet, and which branches at or near the base, *e.g.* the custard apple, *Bauhinia racemosa*, citron, *Randia dumetorum*, *Murraya Kœnigii*, the tea plant, *Mimosa rubicaulis*, &c.

A shrub that assumes the habit of a tree is said to be ARBORESCENT, *e.g.*, *Bauhinia racemosa*, *Murraya Kœnigii*, &c.

A woody plant, which never rises very much above the ground, is called an UNDERSHRUB, *e.g.* *Justicia Adhatoda*, the paper daphne, *Desmodium gangeticum*, &c.

The term BUSH includes undershrubs and every degraded condition of shrubs and trees, in which the plants consist of numerous low spreading branches, such as the various species of *Zizyphus*, oaks, &c., when kept down by fires, grazing, constant lopping, &c.

The word SCRUB denotes a collection of bushes, shrubs, and dwarfed trees.

The collective name of BRUSHWOOD is given to all inferior shrubs, undershrubs, and other bush-like growth, such as

Mimosa rubicaulis, the *Indigoferas*, *Blumea*, *Buddleia*, degraded forms of *Zizyphus*, &c.

The term HERBAGE includes all the growth in a forest which is not woody.

Any plant which cannot rise to any height above the ground, except by attaching itself, as it rises, to some extraneous support, such as a tree, shrub, post, &c., is called a CLIMBER, *e.g.*, *Bauhinia Vahlii*, *Spatholobus Roxburghii*, *Millettia auriculata*, *Celastrus paniculata*, *Butea superba*, the cane palms, &c.

The length of the stem of a tree under its branches is called its BOLE, and the mass of branches with their branchlets and leaves, *i.e.*, the whole of the tree above the bole, is called its crown.

The aerial stems of bamboos are called CULMS, the underground portion being the RHIZOME.

The stem of a palm tree is termed a CAUDEX (plural caudices.)

That portion of the stem which is left in the ground after a tree, whatever its age, has been felled, is called a STOOL. In popular language the word STUMP, besides including stools, denotes the whole portion of the bole of the tree that has been cut or broken off high above the ground.

EPICORMS are the twigs and the branchlets that develop on the boles of trees, when these are suddenly exposed to light.

Dicotyledonous trees, as distinguished from the Conifers, which bear needles, may be termed BROAD-LEAVED trees. (This term has already been employed in anticipation in Part I, Chapter II, Section iii.)

HARD-WOODED trees, or simply the HARDWOODS, comprise in a general manner all trees with tough and heavy wood, as, for example, sal, teak, the *Terminalias*, &c. Similarly the terms SOFT-WOODED trees or the SOFTWOODS include all trees, the wood of which is more or less soft or spongy, such as *Bombax malabaricum*, the *Sterculias*, the horse radish tree, &c.

A forest is said to be PURE, when it is composed entirely, or almost entirely, of a single species, the other species, when any exists, being found only as brushwood or inferior undergrowth; such are the numerous large stretches of babul, of tamarisk, and of *Pinus longifolia*.

When two or more species in varying proportions compose the growth, the forest is said to be MIXED.

A GREGARIOUS tree is one which has a tendency to form more or less extended masses of pure forest, as, for example, sal, sissoo, *Pinus longifolia*, &c. Such trees may also be called EXCLUSIVE; and, as distinguished from them, those trees which only grow in mixed forest, may be termed SOCIAL, such as teak, *Dalbergia latifolia*, *Adina cordifolia*, &c.

EVERGREEN trees are those, the leaves of which persist for at least one year, and do not all fall at the same time; while those, the leaves of which persist for a shorter time, and all fall within a few days, are termed DECIDUOUS. Evergreen trees are, therefore, never leafless, *e.g.* deodar, the pines and firs, mango, &c., whereas deciduous trees may either be leafless during a part of the year, as teak, *Terminalia tomentosa, Adina cordifolia,* babul, or be never quite bare owing to the new leaves coming out while the old ones are being shed, as sal, *Eugenias, Schleichera trijuga,* &c., generally, and sissoo, *Hardwickia binata,* &c., frequently.

The term CANOPIED FOREST denotes a collection of trees of any age, the crowns of which meet.

The LEAF-CANOPY is the continuous mass of foliage formed by the crowns of the trees of a canopied forest. It is said to be COMPLETE, when the branches interlace and form an unbroken mass of foliage. It is said to be OPEN, when the crowns, although they meet, do not touch each other at every point. In the former case, only diffused light can enter the forest below the mass of crowns, while in the latter direct light will also pass through in patches. The leaf-canopy is said to be INTERRUPTED, when there are intervals between the crowns of the trees.

By STOCK or CROP is meant the entire forest growth standing on any given area, and it is said to be COMPLETE for any age, when it is the maximum quantity which the soil can bear at that age.

To STOCK or CROP any piece of ground means to cover it with forest growth. The terms to RESTOCK or RECROP are used when the area in question has once been under forest.

The DENSITY of a crop signifies the degree of closeness of the growth constituting it.

A REGULAR crop is one in which the leaf-canopy, besides being complete, is formed by trees of nearly the same age and size. An IRREGULAR crop, on the other hand, is one in which the leaf-canopy may or may not be complete, but is formed by trees of very various ages and sizes.

A REGULAR FOREST is one which consists of conveniently distributed regular crops, representing every stage of growth from the nascent plant to the tree fit for felling, and covering more or less equal areas or areas of more or less equal productive power. In the contrary case the forest is said to be IRREGULAR, *e.g.*, all our present natural forests.

A shoot springing up from a stool is termed a STOOL-SHOOT.

A young plant, which results directly from the germination of a seed, until it begins to lose its lower branches, is called a SEEDLING.

The term seedling *is also conveniently prefixed as a qualifying word to the words* sapling, pole *and* tree *(for the meaning of*

which terms see below) to denote that the sapling, pole *or* tree *in question has sprung up directly from seed.*

By a further limitation the expression seedling-shoot *is synonymous with a stool-shoot springing up from a seedling cut back either artificially, or by fire, frost, or any other natural cause.*

A ROOT SUCKER or more simply SUCKER, is an aerial shoot given out from a root.

From the time any woody plant begins to lose its lower branches until it has attained a girth of 12 inches it is called a SAPLING.

Thenceforward, until it reaches its full length of bole, it is designated by the general term of POLE. For the sake of further subdivision, poles are termed LOW or HIGH, according as they are under or over two feet in girth.

The pole stage of growth being passed, the plant becomes a FORMED TREE. When there is no risk of ambiguity the word TREE without any qualification may be used in this sense.

When a sapling, pole, or tree is the immediate result of growth from the stool, the qualifying expression ON THE STOOL or ON STOOLS will be affixed, or the word STOOL prefixed to those terms.

A collection of shoots springing up from one and the same stool is called a CLUMP. The term clump is also applied to the collection of culms composing an individual bamboo plant.

When a sapling, pole or tree has grown up from suckers, the term SUCKER will be prefixed to those words.

A HIGH FOREST is a forest composed entirely of seedling trees.

A COPSE is a forest that is composed chiefly of stool-shoots and suckers.

A tree is said to COPPICE well when it produces itself freely from the stool. The verb TO COPPICE is also used in an active sense, and means to fell a crop in order to obtain a *regrowth* from the stools of the trees felled.

TO CUT BACK means to fell any plant, younger than a formed tree, by its base, and this with the object of obtaining, if possible, a fresh growth from it.

TO POLL or TOP OFF a plant signifies to remove its crown.

A POLLARD is a tree that has been polled or topped off.

TO EXPLOIT a forest or crop means to fell it in accordance with the principles of sylviculture. The noun EXPLOITATION corresponds to the verb just defined.

TO REGENERATE a forest signifies to produce a new crop in place of the old exploited one; and the REGENERATION of a forest is accordingly synonymous with the substitution of the one crop for the other.

The regeneration of a forest or crop is said to be NATURAL

or ARTIFICIAL, according as the new crop is the immediate consequence of the exploitation of the old one, or is due exclusively to means extraneous to, and independent of, the old crop and its exploitation.

The name REGROWTH is specially given to the new crop obtained by coppice regeneration (*vide supra* under definition of *to coppice.*)

A ROTATION is the number of years fixed for the successive and complete regeneration of an entire forest.

Regeneration, broadly speaking, may be obtained (i), either by seed; or (ii), by stool-shoot, suckers, &c. When the former is the case, we have the HIGH FOREST REGIME; and when the new crop consists of stool-shoots, suckers or culms, we have the COPPICE REGIME. The régime hence depends on the manner in which regeneration is obtained.

With the same régime, different methods of culture may be adopted, each constituting a separate METHOD OF TREATMENT.

The various species composing a mixed forest may be distinguished into three several classes—PRINCIPAL, AUXILIARY and ACCESSORY.

The PRINCIPAL species is that (there may be one or more) which, from the superior value of the produce it yields, and the general suitability of the prevailing conditions for its favourable growth, necessarily determines and regulates the rotation, régime, and method of treatment to be adopted in a forest.

Of the remaining valuable species well distributed throughout the forest, or capable of being generally introduced there, those are qualified as AUXILIARY, which, possessing different requirements from the principal species, utilize space both in the soil and in the leaf-canopy not occupied by the latter, and in doing so, promote and improve their growth.

All other species, which are neither principal nor auxiliary, are termed ACCESSORY. These are either too slightly distributed, or do not attain a sufficiently large size in the forest in question, or yield produce of too little value to influence in any way the working and treatment of the forest.

Thus in teak forest, teak would be the principal species; *Dalbergia latifolia, Terminalia tomentosa, Schleichera trijuga, Pterocarpus Marsupium, Anogeissus latifolia, &c.*, the auxiliary species; and *Sterculia urens, Odina Wodier, Cochlospermum Gossypium, &c.*, the accessory species. In special cases, however, in the present state of the market, *Dalbergia latifolia* and some other trees classed as auxiliary (e.g., *Hardwickia binata, Pterocarpus Marsupium, &c.*), provided they are abundant enough, may become principal species in company with the teak. Again in sal forest, sal would be the principal species; *Schleichera trijuga, Lagerstræmia parviflora,*

Adina cordifolia, *&c.*, the auxiliary species; and the *Tetrantheras*, *Phœbe lanceolata*, *Buchanania latifolia*, *Semecarpus Anacardium*, *Mallotus philippinensis*, *&c.*, the accessory species. Lastly, in deodar forest, deodar would of course be the principal species; the spruce and silver firs, *Pinus excelsa*, *&c*, the auxiliary species; and species of *Rosaceæ*, *Cornaceæ*, *Celastrineæ*, maples, hollys, &c., would compose the accessory class.

A COUPE is any area in which a felling has been or is to be made, and the produce obtained from the felling is collectively called the FALL.

To CLEAN FELL a coupe means to remove the entire crop standing on that coupe, the corresponding operation being termed a CLEAN FELLING.

When a coupe is not clean felled, the trees left standing are collectively termed the RESERVE. When the reserve is spared long enough for a young forest crop to establish itself under it, this lower crop is termed the UNDERWOOD. As distinguished from underwood the term UNDERGROWTH is generic in its signification, and includes, besides the underwood, all other brushwood, bushes, herbage, &c., standing under any loftier crop of trees.

The seedlings which make their appearance before the mature trees in a coupe are felled will be termed the ADVANCE GROWTH.

A BLANK is any area inside a forest which is bare of trees.

A GLADE is a portion of forest in which the trees are scattered.

The term WINDFALL is applied to trees broken or uprooted by any cause whatsoever, generally by the wind.

HARDY plants are those which resist exposure to frost and drought at all ages, *e.g. Zizyphus*, khair, sissoo, &c. Those which require to be sheltered against frost or drought during their early years are termed DELICATE PLANTS as, for example, teak, deodar, *Terminalia tomentosa*, &c.

Plants which maintain themselves alive under more or less dense shade are said to be SHADE-BEARING, *e.g.*, deodar, sal, silver fir, *Mesua ferrea*, *Hardwickia binata*, *Dendrocalamus strictus*, &c.; while those which can only live in more or less direct sunlight are said to be SHADE-AVOIDING, *e g.*, teak, *Pinus longifolia*, *Pinus excelsa*, &c.

Shade-bearing plants may be *hardy*, like *Mesua ferrea*, *Hardwickia binata*, *Dendrocalamus strictus*, *Acacia Catechu*, &c., or they may be *delicate*, like the silver fir, deodar, toon, *Terminalia tomentosa*, &c.

A plant is said to be growing UNDER COVER, as opposed to its growing OUT IN THE OPEN, when it is vertically under the crown of another plant. Accordingly the COVER of a tree means the action exercised by its crown within the space

below included in its vertical projection. Hence *shade* is not synonymous with *cover*, since the latter is stationary, while the former moves with the sun.

DORMANT BUDS are those which remain concealed under the bark, and burst forth into leaf only under stimulating external conditions, especially where, through natural or artificial operations, there is an absence or insufficiency of other buds to carry off the developmental energy of the plant or organ.

CHAPTER II.—*Struggle for existence between the individual plants of a forest crop.*

Of the plants produced in a forest only a comparatively small number can live the full term of their individual longevity. As they develop, besides extending vertically upwards into the air, and downwards into the soil, they spread out laterally against each other. But since their lateral extension, both in space and in the soil, is obviously limited to the superficies which the forest actually covers, each one naturally struggles to push out its neighbour. In this struggle for existence the stronger and more vivacious plants crowd against or overtop the rest, which hence gradually succumb and disappear one after another at various ages. In other words *the fittest survive*. The conditions that determine this survival of the fittest are extremely complicated, and may best be studied by examining four separate cases which are practically exhaustive.

These four cases, beginning with the simplest, are—

(i.) That of a crop composed of plants of the same age and all belonging to one and the same species.

(ii.) That of a crop composed of a single species, but in which the plants are of all ages, from the seedling just germinating to the tree that has attained its full term of longevity.

(iii.) That of a crop composed of plants of the same age, but belonging to more than a single species.

(iv.) That of a crop composed of trees of all ages and belonging to more than one species.

SECTION I.—FIRST CASE.—*Pure crop composed of individuals of one and the same age.*

In this case, as long as the plants are small and stand apart, they do not impede the free development of each other; the struggle for existence begins only when their crowns meet and close over the ground.

All plants require a certain amount of light, less or greater according to their species, in order not only to grow but even simply to live. Hence those individuals, which do not receive sufficient light, either because they are overtopped or because they are too close pressed laterally, must sooner or later die

and disappear. The conditions which, in the case under consideration, enable the survivors to gain the victory are, therefore—

I. RELATIVE INNATE VIGOUR.—Why one plant should possess more innate vigour than another cannot always be explained; we can only recognize the fact when we observe it. This relative superiority or inferiority, as the case may be, manifests itself as soon as the plants, having left their seed-cap to shoot up into the air, begin to assimilate for themselves. In a seed bed, containing one and the same soil, and with every other condition exactly identical, some plants will be found to be naturally larger, more vigorous, and more hardy than others. Again, stool-shoots are much larger and stronger than, and easily suppress seedlings of their own age.

II. GREATER SUITABILITY OF SOIL AND SUBSOIL.—The influence of soil and subsoil is of only slight importance in the case under consideration, as long as two neighbouring plants are quite young and small; since it is seldom, except in extremely rocky, stony, or uneven ground, that these elements of growth vary from point to point to a sufficient extent to influence differently their development. But when the plants are large enough to stand some distance apart while still touching crowns, this condition may exercise a very marked differential effect on their growth.

III. DEATH, DISEASE, UNHEALTHY STATE, OR RETARDATION OF GROWTH BROUGHT ON BY CAUSES EXTRANEOUS TO THE FOREST, *viz:*—

(a) Attacks of insects and other animals.—Some insects, especially the lignivorous kinds, attack chiefly or solely the weaker plants; while others, like certain caterpillars, and particularly the various silkworms and the larvæ of sawflies, and of certain *Coleoptera*, attack all indifferently, and even rather affect plants possessing abundant well developed juicy foliage. Again, the lac insect prefers the strong juicy shoots of vigorous plants to the more or less dry, more or less hide-bound twigs of less vigorous individuals. Moreover, cattle, goats, and other herbivorous animals, while they do not spare weakly plants, still fall more greedily on strong ones with abundant, well-developed, juicy twigs and foliage. Lastly, man himself will, as a rule, fell and remove only what suits his purpose, the strong as well as the weak plant. Hence it is not invariably, nor generally, the weaker plants that succumb to this cause.

(b.) Attacks of parasitic and epiphytic plants.—Injurious parasitic plants will, as a rule, attack only the weaker individuals; while epiphytic plants make no distinction between weak and strong.

(c.) Damage caused by climatic influences—frost, drought, sunstroke, hail, rain, wind, snow, lightning, &c.—Other con-

ditions being the same, all plants will suffer equally from these causes, especially from frost, drought and hail. But the weaker and lower plant may be sheltered by its more vigorous and taller neighbour, which, as often as not, will be so injured as to allow the former to get ahead of it. The wind might uproot or break off an important limb of the strong tree; under the weight of superincumbent snow one or more large boughs might snap off; lightning might select the tallest or largest tree, and so on; and thus allow the weaker to conquer in the struggle for existence.

(*d.*) *Damage caused by fire.*—Here of course the larger and more vigorous the plant is, the greater will its power of resistance be; but, as often happens, the large tree might be so injured as to throw it hopelessly back in the race of life. In the case of conifers and species which coppice badly, the smaller plants will stand comparatively little chance of recovery.

(*e.*) *Floods.*—Here also it is natural to expect that the resistance offered by the strong tree will be greatest; but a violent rush of water might lay down or strain and injure the roots of the large and vigorous tree, while its weaker neighbour, owing to the very fact that it opposes slighter resistance, might be bent down for the moment only, to rise up again as soon as the flood has passed, and shoot up ahead of it.

(*f.*) *Injuries caused by felling, conversion, and export operations.*—The smaller and weaker plants will, of course, on the whole, suffer most, but the fall of a large tree is more likely to break and throw back for ever plants with a rigid, more or less unyielding stem than those which simply get bent down for the moment until the fallen tree is removed.

(*g.*) *Climbers.*—Climbers kill or at least unfit trees for the struggle for existence in four different ways—

(i.) They may strangle the stems of their supports, narrowing year after year the channel through which alone the sap, pumped up by the roots, can ascend.

(ii.) They also bend down these stems by their weight.

(iii.) When they get up into the crowns of their supports, they invade and overspread these crowns, which cannot, therefore, bear their full quantum of foliage, and are also thereby impeded both in their lateral and upward development, especially in the latter.

(iv.) They distort the boles of their supports, and thus necessitate the removal of these latter by the forester.

IV. DENSITY OF THE LEAF-CANOPY.—It is obvious that the plants, which have free space round and over them, will keep on growing and survive, while others, taller and stronger than they, but less so than their immediate neighbours, succumb under this cause.

Every species whatsoever, whether shade-bearing or shade-avoiding, can form a denser leaf-canopy when young than at a later age, and their need for light increases directly with age. In a complete crop the density of the leaf-canopy remains at its maximum up to the time when the trees have nearly attained their full length of bole. Thenceforth the leaf-canopy becomes gradually sparer, until, at a very advanced age, varying with the species concerned, the individual trees stand completely isolated.

The more favorable the soil and locality is, the closer together can the trees stand at any age; and, in general, the presence of sufficient moisture in the soil and in the atmosphere, combined with the requisite temperature, increases the ability of a species to form a dense leaf-canopy at all stages of growth, by encouraging the development of foliage, and hence the spread, depth, and thickness of the crowns.

All species form a denser leaf-canopy the longer the period of vegetation in each year is, for when this period is short, the action of light ought, in order to produce the same effect, to be more energetic in proportion, and the trees must, accordingly, stand further apart.

Lastly, the greater the intensity of sunlight at any place is, the more shade-bearing does a given species become; and conversely, the less intense the light, as, for instance, on northern aspects, in mist and fog-clad regions, under generally clouded skies, &c., the further apart will the trees grow, and the more will they object to being overtopped. Moreover at high elevations diffused light has more effect on vegetation than at lower altitudes; hence the higher a place is above the sea-level, the denser will be the growth of any given species.

If the species composing the crop is shade-bearing, like the deodar, silver fir, *Quercus incana*, *Terminalia tomentosa*, *&c.*, or one which at all ages interlaces branches, like the khair, species of *Zizyphus*, *Anogeissus pendula*, *A. latifolia*, &c., the struggle for existence is a long and severe one. On the other hand, when the constituent species is like the *Pinus longifolia*, or the *Hardwickia binata*, the first shade-avoiding from its earliest years, and both abhorring the interlacing of branches, the struggle is a brief one, and the weaker and overtopped plants are soon thrown out of the race.

Examples of the First Case.

Natural instances of the First Case may be found in the tamarisk forests of Sindh and in some of the babul forests of the same province; also in bamboo forests, the constituent species of which flowers gregariously. Another striking instance is offered by copses of a single species that are clean-felled, in which, practically, all the stool-shoots spring up the very first season following the exploitation. This of course

includes the forest standing on land at one time subjected to the barbarous system of cultivation known as *jhooming, kumri, kil, toungya, dhaya, &c.*, in the various provinces of India, which consists in clearing and burning off all the vegetation on the ground, raising one or two crops on the ashes, and then taking up fresh areas, not to return until the forest is again old enough to yield a sufficient supply of ashes. Such are many of the pure teak copses of the Sathpuras, &c.

As artificial examples of this First Case we may quote plantations formed of a single species.

SECTION II.—SECOND CASE.—*Pure crop composed of individuals of all ages.*

In this case, contrary to what happens in the one just treated, the struggle for existence is always going on without lull or relaxation. New plants are constantly being produced wherever the leaf-canopy opens out sufficiently to allow them the smallest chance of life. Here the determining conditions for the survival of the fittest are—

I. INNATE VIGOUR.—The importance of this condition is not so great as in the First Case, for Condition V (which see) may quite nullify it.

II. GREATER SUITABILITY OF SOIL AND SUBSOIL.—This condition acts here exactly as in the First Case, with this addition, however, that where the soil is very wet or stiff, the older plants possess the advantage; and, inversely, where the subsoil is impenetrable sheet rock or clay, or impermeable to water, or, on the other hand, waterless, the younger plants are able to live, while the older wither, decay, and die off as soon as their roots reach this unfavorable subsoil.

III. DEATH, DISEASE, UNHEALTHY STATE, OR RETARDATION OF GROWTH BROUGHT ON BY CAUSES EXTRANEOUS TO THE CROP, *viz.*:—

(*a.*) *Attacks of insects and other animals.*—The same remarks hold here as in the First Case. Besides this, it must be mentioned that animals, especially cattle and deer, are less likely to damage large than small plants.

(*b.*) *Attacks of parasitic and epiphytic plants.*—Exactly as in the First Case.

(*c.*) *Damage caused by climatic influences.*—The remarks made under the First Case apply with still greater force here. Young plants, coming up under lofty trees, will be perfectly safe against frost, hot and cold winds, snow, and, to a great extent, from drought and hail; on the other hand, the drip from the trees above might prove dangerous to young seedlings. Again, the older individuals, with large and long roots, extending everywhere in the direction of moisture, are guaranteed against the severest and most protracted drought.

(*d.*) *Damage caused by fire.*—The effect of this condition

is the same as in the First Case, except that the young plants, as compared with the formed trees, especially if they are conifers, and hence, as a rule, unable to shoot up again from the collum of the root, stand little chance of resisting a fire.

(*e.*) *Floods.*—In this case there can be no doubt that the larger trees of the crop will resist much stronger and heavier floods than their smaller companions, even if the species in question is a denizen of flooded land. For further observations refer to the First Case under the same head.

(*f.*) *Injuries caused by felling, conversion and export operations.*—It is obvious that the younger and more slender the plant is, the more damage will it suffer from this cause. Nevertheless, within certain limits, the younger tree will recover sooner than an equally damaged old tree.

(*g.*) *Climbers.*—Exactly as in the First Case. Climbers are no respecters of age, nevertheless a large tree will obviously succumb less easily when attacked than a smaller one.

IV. DENSITY OF THE LEAF-CANOPY.—All the remarks made under this head in the First Case apply with more force here. As said there, the young plant of any species is more shade-bearing than its older fellows, and this difference is most marked in the case of trees that are very partial to light, like the teak, *Hardwickia*, *Pinus longifolia*, sal, &c.

V. AGE.—In a general sense the older plant will be stronger than one some years younger; but a time arrives when the vigour of a tree diminishes, its crown contracts and becomes spare, letting in light and forming gaps in the leaf-canopy. The younger trees, hitherto overtopped by it, but now endowed with greater vigour, are henceforward able to push up through these openings, pressing in still more the crown of their old companion until they finally hasten its death.

Examples of the Second Case.

Instances of the Second Case are abundantly offered by large tracts of *Pinus longifolia* forest in the North-West Provinces and the Punjab; of babul and of sissoo in Northern India, in Sindh, and in the Northern Deccan; of khair and of sal in Northern and Central India; of *Hardwickia* in Central and Southern India; of *Mesua ferrea* in Assam, &c.

SECTION III.—THIRD CASE.—*Mixed crop composed of individuals of one and the same age.*

In the two preceding cases we had to deal with pure crops, the individuals of which necessarily differed from each other only in respect of comparative vigour, size, and age. In this, the Third Case, a very complicated element enters, for no two species, however similar to each other they may be, can possess the same habit of growth, or the same requirements

as to soil, climatic influences, and locality, or the same longevity or vitality, or the same liability to damage from various causes, or equal facility of reproduction, &c. Hence the conditions which determine the survival of the fittest plants of the crop are much more numerous, and extremely complicated by their acting simultaneously, and often more or less nullifying each other, or producing joint effects which sometimes defy analysis. Their consideration is also all the more difficult, as they run one into another, and cannot always be studied apart.

I. INNATE VIGOUR.—Though not less important here than in the two preceding cases, this condition has not so far reaching an effect as those which follow, for these latter may totally nullify any advantage possessed by a plant in respect of innate vigour alone.

II. GREATER SUITABILITY OF SOIL AND SUBSOIL.—The influence of this condition is extremely great, and is sometimes the sole effective cause of a forest being more or less pure. Thus, for instance, the eng *(Dipterocarpus tuberculatus)* will drive out all other species from laterite in Burma, the *Terminalia tomentosa* the teak from wet binding soils in the Central Provinces. The sissoo alone can grow on the alluvial shingly banks and beds of some rivers; and so on. Even in a limited area the soil may vary from point to point in respect of one or more of its principal properties—physical and chemical composition, depth, hygroscopicity, compactness—all these various differences favouring one species at the expense of another, besides producing marked differences in the vigour of plants of the same species.

On shallow soils resting on a compact subsoil, surface-feeders will thrive better than trees that send their roots deep into the ground; and similarly species that throw up suckers than others not possessing that faculty, which, indeed, is increased in such soils.

The soil also influences reproduction to a very considerable extent. If it is hard or caked at the surface, or dry, species producing seed which germinate with difficulty, *(e.g.,* teak, &c.), or are so large that they are either washed away or insufficiently covered (teak, the *Terminalias*), stand little chance against such of their companions as produce smaller seed that is caught in little crevices or depressions (*Anogeissus*, *Rhododendron*, &c.), or seed that germinates more readily (sal, &c.). Moreover in such soils, species, the young seedlings of which develop a strong taproot, capable of forcing itself into the ground *(e.g*, teak, sal, &c.), are bound to prevail over their less favoured companions. In loose, free, moist soil the victory will obviously be little dependent on the size of the seed.

III. DEATH, DISEASE, UNHEALTHY STATE, OR RETARDATION OF GROWTH, BROUGHT ON BY CAUSES EXTRANEOUS TO THE FOREST, *viz.*—

(a.) Attacks of insects and other animals.—The remarks made under this head for the first two cases are equally applicable here. Besides this, we know that with many insects certain species are characteristic of, and limited to certain kinds of trees, that cattle and deer will greedily devour the foliage of some kinds and leave others untouched; and so forth. Thus, for instance, it is not uncommon to see every teak leaf over large tracts of the Central Provinces eaten up by a certain species of caterpillar in the space of a few days, while the foliage of the various companion species entirely escapes the pest. Similarly, the foliage of sal is attacked and more or less completely devoured over large areas by the larva of a certain species of insect *(Tinia)*. Again, a borer *(Cerambyæ)* often attacks young teak shoots, piercing the wood up to the pith, where it lodges, and thus either kills the portion of the shoot above the wound, or stops or retards its growth, or allows it to be easily snapped off by the wind. In some of the forests in Saugor, in the Central Provinces, young *Stephegyne parvifolia* have no chance of getting up, as the tender annual shoots are devoured by deer as fast as they come up. So in the Himalayas, *Quercus incana*, *dilatata*, and *semecarpifolia*, can never rise above a mere bush where grazing is unrestricted. On the other hand, *Hardwickia* and, in many places, sal seedlings are seldom, if ever, touched by the mouth of cattle.

The intervention of man also exercises a greater influence here than in the preceding cases, and not unfrequently results in the complete banishment of certain species. Large and frequent clearings for cultivation or other purposes may enable the more vivacious species to get ahead of, and suppress, all others (examples, teak, *Ougeinia*, *Zizyphus*, &c.). A large demand for certain kinds of produce may create a heavy run on the few species which furnish them, and thereby enable their companions, even those which are naturally less fitted to survive, to fill up the vacancies left by them, and secure the mastery.

(b.) Attacks of parasitic and epiphytic plants.—All the remarks made under this head for the First Case apply also here. Moreover parasites are nearly always selective, preferring some species to others, or living exclusively on a single species; and so, although to a much less extent with many epiphytes. Thus the *Arceuthobium Oxycedri*, as far as is known, grows in India only on the *Juniperus excelsa*, gradually overspreading the plant on which it has once taken root, often killing the branch or the entire tree. Precise information under this head is wanting in India, and more careful and extended observations are urgently called for.

(*c.*) *Damage caused by climatic influences.*—Under this head we will include injury suffered from the causes in question by *individual plants*, irrespective of the influence they exercise on the *general growth* of each species considered collectively. The consideration of this influence introduces a much larger question, the extreme importance of which requires that it should be treated under a separate major head (see No. VIII below). This reservation being understood, no further remarks are called for than what have already been made on this subject under the first two cases.

(*d.*) *Damage caused by fire.*—The influence of this source of injury is very considerable. First of all, it may be said, that broad-leaved species resist fire better than conifers, since the first are able to recover, thanks to their faculty of shooting up again from the stool; whereas the latter (*Pinus longifolia*, deodar, yew and larch excepted, strong plants of which are sometimes able to grow up again from some point close to the ground) are killed outright once the vitality of their buds is destroyed. And besides this, as the needles, cones, fallen twigs and branchlets, and the bark of conifers are always more or less resinous, the relative severity of any conflagration that may occur is naturally very great, and standing trees, with thick dry bark full of resin, are easily exposed to be burnt down. In the second place, as regards the broad-leaved species themselves, their degree of resistance to the effects of forest fires will depend (i) on the evergreen or deciduous nature of their foliage; (ii) on the vitality of the collum of the root; (iii) on their ability to throw up suckers; (iv) on the number and vitality of their dormant buds; (v) on the density of their foliage; (vi) on the season at which they put forth new leaves; (vii) if they are deciduous, on their season of leaf-fall; (viii) on the time of the year at which they shed their seed; (ix) exceptionally on the ability of their seed to resist the destructive effects of fire; (x) on their ability to form at once a strong new leader when the original one has been killed; and (xi) on the vivaciousness of the bark, *i.e.*, the readiness with which it re-forms under burns, cracks, &c.

With regard to (i) it is evident that with an evergreen leaf-canopy the moisture of the soil would be maintained at its maximum, there would be little combustible undergrowth on the ground, and, if ever a fire occurred, it would only smoulder, or at the most rise only a few feet above the ground. With respect to (ii) it is obvious that the persistence of young plants, especially before they have become saplings, is due almost entirely to their ability to throw up shoots from the collum of the root when their aerial portion has been destroyed by fire. As for (iii) it is well known that when any species is able to throw up suckers, forest fires, by weakening the standing individuals, only increase this tendency; witness the large stretches of

almost pure *Ougeinia dalbergioides* in the dry forests of the Sathpuras. As regards (iv) it is evident that the greater the number of dormant buds is, the more likely are there to be some that have escaped destruction. With respect to (v) it is enough to say that trees with dense foliage have naturally very little undergrowth below them with which to feed the flames and draw them up into their crowns. For instance, *Hardwickias*, with their open foliage, encourage a close undergrowth round their trunks, the consequence being that, when fire comes in, the flames rise up to the summit of the highest crowns, which, although quite green, blaze up like tinder. With reference to (vi) everyone knows that, if a fire occurs when the new leaves are in the process of coming out, they are generally all destroyed, and the trees that are not killed outright can put forth only a very poor second flush in consequence of the paucity of the surviving buds. Again, should a fire occur before the buds begin to swell up, preliminary to bursting into leaf, it is a physiological fact that their vitality, owing to their then containing a minimum quantity of moisture, is less easily destroyed than afterwards. Hence, generally speaking, even irrespective of the fact that the brushwood and herbage below is then drier, the later a fire occurs the more likely is it to find the trees either in full leaf or with the new flush just coming out, and hence the more likely to do greater damage. In connection with (vii) it is obvious that the longer the leaves persist, the less will probably be the quantity of inflammable material on the ground; and besides this, the violence of any fire that may occur will be proportionately diminished by the impediment to the production of wind offered by the standing mass of foliage. With regard to (viii) it is a truism to say that if fire enters after the seed has fallen, there is very little chance of any of it escaping. With respect to (ix) we know that the fruit of some species, like the teak, the *Terminalias*, and others, can stand a very high temperature, less or more prolonged, without the germ being thereby killed. As concerns (x), it is evident that species, individuals of which can at once re-form a new leader when the old one has been killed or broken off, possess a considerable advantage over others which possess this faculty in a less degree. Lastly, what we have said under (xi) is obvious and requires no explanation.

(e.) Floods.—All previous remarks under this head apply equally well here. Moreover, the extent of damage done by floods depends on the different species according to the respective degrees of resistance they offer to a rush of water, and to the respective ability of each to withstand the temporary excess of moisture round all its roots. For instance, in most sundri forests the ground is muddy throughout the year. Sissoo, khair, babul, *Terminalia arjuna*, &c., can flourish

with the soil under water for a more or less long period, whereas teak, sal, and other species are, to say the least, thrown back if the floods last any time.

(f.) Injuries caused by felling, conversion, and export operations.—The ability of a plant to resist such injuries will depend—

(i). On its faculty of shooting up again from the collum of the root, or of throwing up suckers from the roots.
(ii). On the firmness and strength of its roots.
(iii). On the strength and elasticity of the trunk.
(iv). On its ability to re-form at once a strong leader, when the original one has been broken or killed.
(v). On the vivaciousness of the bark, *i.e.*, its readiness to form and close over wounds and bruises.

All these points are self-evident, and require no explanation.

(*g*). *Climbers.*—The remarks made under this head in the First Case apply with equal force here. Besides this, it may be added that climbers are in no sense selective as regards the species of tree along which they rise above the ground. Usually they are confined to rich or at least moist soils, and are hence peculiarly destructive to species that affect those soils.

IV. DENSITY OF THE LEAF-CANOPY; RELATIVE DENSITY AND SHAPE OF CROWN, AND RELATIVE CAPABILITY OF PERSISTING UNDER OR PUSHING UP THROUGH COVER.—It will be noticed that the second clause of this heading is additional to what appeared in the two previous cases. Its necessity is evident, for with only a single species in the crop, all the plants are necessarily equally able or equally unable to persist under or push up through cover overhead; whereas the moment a second species enters the crop, the relative ability of the two in this respect becomes a most important element in the mutual struggle for existence, and has hence to be considered. Moreover, the relative density and shape of the crown of any species regulates, to a considerable extent, its proportion in a mixed crop.

As a rule, the denser the foliage of a species is, the more shade-bearing will young individuals of it be. Instances in point are deodar, silver fir, mango, *Buchanania latifolia*, *Eugenias*, laurels, *Terminalia tomentosa*, *Diospyros Melanoxylon*, *Stephegyne parvifolia*, *Mimusops indica*, *Pongamia glabra*, bamboos, the holly, *Quercus incana*, &c., &c. Hence those species have obviously, as far as this condition alone is concerned, a great advantage over such of their companions as are shade-avoiding, the crowns of which are generally more or less open. While young individuals of the former can ultimately get up into the leaf-canopy above, which end is rather facilitated than otherwise by the overhanging trees of the other class acting as nurses, the young of these latter are not only subject to suppression by the leaf-canopy above, but are also elbowed out by

their shade-bearing companions in the undergrowth. Thus where sal and *Pinus longifolia* meet, although pine seedlings are produced in abundance, they are very soon choked up and overtopped by young sal, which gives them no chance of existence except where the soil is too poor and dry for it. Similarly, although deodar and the silver fir are both shade-bearing species, still the superiority which the latter possesses in this respect, gives it a complete mastery over the other on moist aspects, the young silver fir being able to live with unimpaired powers of recovery under dense cover up to 30 and 40 years of age, and even more.

Some trees there are, which, although after a certain age they cannot flourish except with their crowns free on every side, yet, during their early years, are able to stand a great deal of shade. A very remarkable instance of this is the *Hardwickia binata*, seedlings of which will persist under dense and even low cover for ten years and upwards. Again young *Pinus longifolia* seedlings are not unfrequently to be found, if not absolutely vigorous, still full of vitality, under low, bushy *Quercus incana*. Nay teak itself will live for years as undergrowth in forests of medium density, consisting of bamboos, *Pterocarpus Marsupium*, *Terminalia tomentosa*, *Cochlospermum Gossypium*, *Boswellia thurifera*, *Hardwickia binata*, *Anogeissus latifolia*, &c.

The shape of the crown also exercises a considerable influence on the struggle for existence. Sal, with its long narrow crown, is able to push up through any small gap it may find in the leaf-canopy above it. Shade-bearing trees will at once spread out a branch here and a branch there into any interstices they find. Of two species growing side by side and possessing similarly shaped crowns, but one of which is more shade-bearing than the other, the second will ultimately disappear; whereas a third species, although much less shade-bearing than the second, but with a differently shaped crown, will be able to occupy a permanent place in the leaf-canopy.

Lastly, the relative ability of trees to push up through cover has to be considered. Facility for doing so, added to the faculty of persisting under cover, gives a tree, possessing it, an irresistible superiority over its neighbours. The manner in which young deodar makes its way through the dense crowns of overhanging oaks and rhododendrons is an excellent instance in point. But there are certain shade-avoiding trees also, which, thanks to this facility, are able to force themselves not only into, but through, the leaf-canopy above. Such species are either comparatively very rapid growers, or, from being in leaf and putting forth new shoots while their companions are entirely leafless, are able to spread out, both laterally and upwards, in spite of being overtopped or pressed in by

the crowns of these latter. The most remarkable instance of the first case is that of the *Dendrocalamus strictus* and other bamboos generally, which, although extremely partial to light, will shoot up through the loftiest and deepest cover. Again, the strong leader of the teak will, provided it has not far to go to reach direct sunlight, pierce through the thickest tangled mass of foliage overhead. The second case is best illustrated by the *Hardwickia binata*, young plants of which gradually insinuate themselves through the crowns of the trees immediately above them, especially of khair and, of course, of *Boswellia*. Indeed the finest saplings are often those which have grown up in this manner through khair (see Condition XII, *infra*.)

V. RELATIVE LONGEVITY.—This factor has a most important influence on the struggle for existence. That influence is so great that of itself it enables a species, placed at a disadvantage with regard to its companions in most other respects, to prevail in the end. The best instance of this is offered by the teak, which, in spite of every kind of ill-treatment, and of an ungrateful soil and climate, is able to form extensive copses on the dry barren hills of the Sathpuras and Southern Vindhyas. In the same way the sal, although gregarious and fast growing species like the *Tetrantheras*, bamboos, &c., may gain the upper hand of it at first, still lives long enough to see these disappear and leave it in complete possession of the ground. Indeed the greater longevity of the more valuable species seems to be a special dispensation of nature, otherwise useless and inferior kinds, like the *Cochlospermum Gossypium*, *Kydia calycina*, *Helicteres Isora*, *Mallotus philippinensis*, *Zizyphus*, *Mimosa rubicaulis*, *Indigoferas*, *Justicia Adhatoda*, *Blumea*, *Buddleia*, *&c*, would simply choke up and drive out all better growth.

VI. RELATIVE RAPIDITY OF GROWTH.—The influence of this cause will be different according as this relative rapidity obtains during the first years of the life of a tree or at a later age. Other circumstances being equal, it is evident that species which grow rapidly during their early years will prevail over others which are of slower growth at that age. And similarly stool-shoots and suckers will very soon smother out any seedlings that may come up simultaneously with them. In the habitat of the teak, bamboos everywhere, *Butea frondosa* in Central India, and some other species, complete at least half their growth before that valuable tree only begins to push upwards, the consequence being that, unless this last has a real start, it is completely driven out. In most sal forests, besides the bamboo, it is the *Tetrantheras* that push up rapidly and cover the ground, while the sal is only just establishing itself. Among the companions of deodar, the *Pinus excelsa* shoots rapidly away soon after it germinates, and leaves that tree far behind in the race. It is thanks mainly to the wonderful

rapidity with which teak stool-shoots grow up, that that species is so easily able to hold its own in the coppice forests of the Sathpuras and the Western Ghats. On the other hand, when growth becomes rapid only after the plants have attained a certain age, its vigour in the case of the larger trees of the forest is always so great that nothing can withstand it. It is thus that when teak has survived up to this stage it overcomes every obstacle to its growth, and so with sal, deodar, *Pinus longifolia*, *Hardwickia binata*, &c

VII. RELATIVE MAXIMUM HEIGHT ATTAINABLE.—This condition finally decides what trees, out of those that survive up to a certain stage of growth, shall form the crop, or, if there are species present which are shade-bearing enough to constitute a permanent undergrowth, its upper story. Of the companions of sal there are only the *Terminalias*, some *Albizzias*, *Adina cordifolia*, *Pinus longifolia*, some *Eugenias*, and half a dozen other species which attain the same height as that noble tree, and which, therefore, compete with it for a place in the lofty leaf-canopy of the full-grown forest. In most of the forests of Central India (including Northern Bombay), teak is a small tree, and is hence easily beaten by its taller companions. Deodar is, as a rule, the tallest tree in the forests where it grows, whence its gregariousness in those places, where other circumstances, such as soil, moisture, &c., are favorable. Again, *Mesua ferrea* is, with the exception of *Altingia excelsa*, the tallest tree in the large areas which it covers almost by itself in Assam. The teak in Burma, and the *Artocarpus Chaplasha* in Assam, although unfavorably circumstanced in many other respects to struggle for existence with their companions, are able to hold a permanent place in their midst. In evergreen forests trees of deciduous species tower above all the other growth.

VIII. RELATIVE SUITABILITY OF CLIMATE.—This is perhaps one of the most important conditions in the struggle for existence, for in almost every case it determines the habitat of the various species, and also the vigour of their growth. Many factors go to make up what is called climate, and they may best be considered separately :—

(a.) Heat and frost.—The influence of these factors is due chiefly to extremes, being very little or scarcely appreciable within limited ranges of temperature. Thus the minimum temperature of the cold weather months in the region of teak ranges from several degrees below frost in Narsingpur in the Central Provinces, to 59° in Bombay and in Rangoon, the mean temperature in those places during the same months being respectively 62°·4, 75°·7, 75°·6. It is only when these extreme ranges are approached that the teak has to give way to other species. In Sindh, the Chaors and Kachas along the lower course of the Indus are covered chiefly with babul ;

higher up the river frosts become very severe, and tamarisk gets the upper hand of babul. In the Changa Manga Plantation frost has killed out the babul, and left the sissoo complete master of the ground. Sal retreats before the hot dry winds of the open plains of North-West India. Nevertheless within one and the same habitat some species resist frost, or recover from injury caused by it, much better than others. This fact accounts for the actual proportion or entire absence of certain species in many forest crops. Thus teak, the young plant of which is very sensitive to frost, is eliminated or kept down by it in many tracts in the Central Provinces and in the northern portions of the Bombay Presidency. For the reason that khair and sissoo stand very low temperatures, they grow almost pure in damp, low, frosty situations. On exposed southern slopes *Pinus excelsa* drives out deodar.

The sensitiveness to frost of plants is directly proportional—(i) to the size of the leaves and the roughness of the buds, leaves, and internodes; (ii) to the quantity of water in the cell-sap as compared with solid substances; (iii) to the looseness of texture of the living tissues; (iv) to suddenness of thaw; (v) to the thinness and late formation of the outer covering of dead bark (the *rhytidome*); (vi) to shallowness of rooting; and (vii) to the quantity of watery vapour in the atmosphere. We may hence deduce the following corollaries, granting always that other circumstances are equal:—(*a*) the more active the vegetative processes during the season of frosts, the more sensitive the tree; (*b*) the greater the number of dormant buds, the hardier the species; and (*c*) the more generous the growth of a young plant, the slighter its power of resistance.

Besides influencing the development of individuals of the various species, temperature also affects their ability to bear flowers and fruit (see Condition IX, *a* and *b*).

(*b.*) *Damp and drought.*—Here also only extremes act. For instance teak seems to thrive best under a mean annual rainfall of from 50 to 120 inches, but does not disappear till the fall decreases to about 24 inches. Even the range of rainfall for sal extends roughly over 80 inches, *viz.*, from 40 to 120.

In the dry climate of Rajputana the *Anogeissus pendula* easily gains the ascendancy over all other species. The jand (*Prosopis spicigera*) finds no rival or compeer in the dry rakhs of the Punjab.

Under damp must be included, besides rainfall, also relative humidity. The sal will acquire its finest dimensions in the hot steamy valleys of the Lower Himalayas, but refuse to grow in Chanda and other places where the temperature during the hot weather is scarcely higher, but where nightly dews are neither heavy nor occur during any considerable part of the dry season. Possibly the natural spread of sissoo, south of

its range, is limited by the drier atmosphere of the adjoining region. The very high relative humidity of the inner ranges of the Himalayas enables evergreen species to prevail there, notwithstanding the low rainfall they receive.

The abundance and continuousness of rain at the beginning of the rainy season exercises a very strong influence on the germination of the seeds of the various species. The seeds of some species have to go through a long process before they become perfect plants. A sudden break in the rains, and a few hours of strong sunshine during this process, might kill the majority of such germinating seeds. This happened over several square miles in the Khandwa Reserve in Nimar, in the Central Provinces, in 1879, in the case of the *Hardwickia binata*. Again, if the monsoon rainfall is at first short, and the seed of any species, like teak, which requires plenty of moisture, germinates in consequence only in the latter half of the season, the young herbaceous plants must fall easy victims to the hot sun of October and November and the frosts of December and January.

Lastly, it may generally be said that those species, the seedlings of which develop a strong, long taproot, will withstand severe and continued drought and thus survive, while others, less favoured in this respect, will disappear or be left in the minority.

Besides influencing the growth and soundness of individuals of the various species, the amount of atmospheric moisture affects also the abundance and frequency with which they flower and seed (see Condition IX, *a* and *b*).

(*c*.) *Light, its intensity and duration.*—Here also it is the action of extremes that exercises any appreciable influence on the struggle for existence. Some species cannot make any useful growth, except under exposure to direct sunlight. These form the majority of our Indian species, and include teak, sal, &c. Others, like the *Quercus incana*, silver fir, &c., will flourish and attain their finest dimensions even in diffused light, without seeing a single direct ray from one end of the year to the other. The figs require a great deal of direct sunshine, and hence their arboreal habit. Going out of India to Northern Europe we have the Scotch fir and birch delighting in almost perpetual sunshine during half the year, and able to survive almost endless night during the other half. As rather more than one-half of India is situated within the Tropics, and of the rest the greater portion consists of level ground fully exposed to the sun, and within a few degrees of the Northern Tropic, the climatic influence of light, as opposed to so much of it as was considered under Condition IV, is not important except for a very few species, such as the *Pinus excelsa*, deodar, and some other Himalayan trees, which require good illumination, but cannot stand heat, both

of which conditions are satisfied by the altitude at which they grow. But this is anticipating subhead *(e)* below.

Besides influencing the development of individuals of the various species composing a forest crop, the greater or less intensity of the light acting on their crowns, according to their different degrees of isolation, also affects the frequency and abundance with which they flower and seed (see Condition IX, *a* and *b*).

The intensity of light being the same, the longer its duration is, the more shade will the various species be able to bear, and *vice versa*. Then, again, the more intense the light is, the better are the various species able to grow under cover, and form a dense leaf-canopy. And, lastly, diffused light is more powerful in its effects on vegetation at high than at low altitudes (see Condition IV, under First Case).

(d). *Aspect*.—In hilly and mountainous country the influence of this condition is very great, often of itself determining the distribution of certain species. In Southern Nimar, in the isolated block of hills known as the Sambar Deo range, on the left bank of the Tapti, the southern slopes bear *Hardwickia binata*; while the northern ones, being cooler and moister, are covered chiefly with a dense teak copse, a rare *Hardwickia* being visible here and there. In the outer North-West Himalayas, *Pinus longifolia* generally affects the warm southern and eastern aspects, while oaks with rhododendron clothe the northerly and westerly slopes. Nevertheless lower down, where sal and that pine meet, the latter, which is a tree of a colder climate, is represented chiefly on northerly and westerly slopes, the sal occupying the warmer aspects. Going up higher, into the region of deodar, *Pinus excelsa* is the ruling tree on southerly aspects; silver fir, spruce, *Quercus dilatata*, and *semecarpifolia*, with maples, birch, *Celtis australis*, &c., predominate on cold northerly and westerly aspects; while deodar prevails in the middle ground.

In dry districts in Central and Southern India the *Dendrocalamus strictus* affects the cooler northerly and westerly slopes; whereas in Bengal and along the foot of the Himalayas generally, where the climate is damp, it is found chiefly on the warm southerly faces of the hills. In other words, the aspect affected by a species may vary with the amount of atmospheric humidity of the localities in which it grows.

Aspect is always intimately connected with altitude, as will be seen under the next subhead.

(e). *Altitude*.—The main effect of altitude is to reduce temperature, but it has, besides the important effect of prolonging the duration of sunlight, and, by reason of the clearness and rarity of the atmosphere due to it, of increasing the effect of the sun's rays. Hence it often reverses the effect of aspect, as we have already seen under the preceding subhead in the

instance of the *Pinus longifolia*. Another example is to be found also in the outer Himalayas in Kumaon, where oak forest, although chiefly confined to cool northerly and westerly aspects, takes complete possession of southern slopes from the line where *Pinus longifolia* stops. At the upper limit of tree vegetation the effect of aspect is entirely nullified by altitude.

(f). *Winds, their direction, violence, and prevalence.*—The influence of winds on the struggle for existence between the plants of a forest crop is threefold. In the first place, by their violence they can uproot, injure the roots of, break off, and mutilate, distort, and stunt the trees; in the second place, they can alter the relative humidity of the locality according as they are drier or moister than the latter; and in the third place, they can reduce or raise the temperature according as they previously pass over a colder or hotter region. And all these various effects may be slight or aggravated according as the wind is intermittent and local, or constant and of long duration.

Of two trees of the same species, that one will resist better the force of the wind which possesses the broader crown, since the extent of the roots is proportional to the size and vigour of the crown. Again, of two species, one may be deep-rooted, while the other has its roots more or less superficial, and is consequently less able to resist violent movements of the atmosphere. Hence where storms and gales are frequent, as on ridges, spurs, peaks, in narrow gorges, or on the sea coast, the strong-rooted individuals will be the ultimate survivors; and species with weak superficial roots will have to retreat to sheltered localities.

IX. SEEDING.—This condition may be considered under six subheads, as follow:—

(a). *Its relative abundance.*—It is evident that, other circumstances being the same, a species that produces abundant crops of seed will, even if at first in the minority, secure an easy predominance. Instances of profusely seeding species are bamboos (*facile principes*), sal, sissu, deodar, *Quercus incana* and *semecarpifolia*, *Pinus longifolia*, teak, &c. In the Dehra Doon *Excœcaria sebifera*, an exotic, drives out indigenous trees in most places where it has established itself, thanks to its abundant annual seeding. In Mauritius *Tetrantheras*, *Albizzia Lebbek*, and other trees, introduced from India, and seeding more abundantly than the indigenous trees, now occupy by themselves whole hill sides.

Some trees, which are accommodating to climate, although abundant seeders in the heart of their habitat, produce only a small crop of seed near its confines, as, for instance, teak, *Pinus longifolia*, &c.

Of two species possessing equal longevity, that which seeds at an earlier age is also the one that seeds more abundantly.

For instance, the teak, babul, *Anogeissus*, sissu, sal, &c., are, among our species, those which seed in greatest profusion.

Some species require a larger total sum of heat than others in order to flower, and hence also to seed. Hence comparatively poor seed crops where a species occurs in a climate appreciably colder than that of its main habitat.

Again, some species require a less degree of isolation for their crowns than others, in order both to flower and bear fruit. Such species are also always more shade-bearing. Hence in a more or less completely canopied forest this class of trees will form more or less exclusively the next crop of seedlings, and consequently either drive out or leave in the minority their companions (if any exist) less favoured in this respect, even if these latter at first predominate in numbers. Thus sissu, khair, *Dalbergia latifolia*, *Anogeissus pendula*, &c., require less isolation than teak, *Pterocarpus Marsupium*, &c.

Lastly, all woody species produce most flower buds in a dry year. But in the case of some of them, as for instance *Hardwickia binata*, sissu, khair, &c., once they have put forth blossoms, subsequent hot or cold weather scarcely affects the development and ripening of the fruit. With others, on the contrary, such as sal, teak, deodar, &c., if unfavórable weather does not result in the destruction of the entire crop of flowers, only a relatively small proportion of it survives to become mature fruit.

(*b*). *Its relative frequency.*—While with some species, like sal, sissu, khair, *Anogeissus latifolia*, *Anogeissus pendula*, *Terminalia tomentosa*, &c., generally, and teak and *Pinus longifolia* within the main range of their habitat, seed-bearing trees in numbers are never wanting in any year. With others, on the other hand, like the *Hardwickia binata*, some bamboos, &c., not a single tree will be found even in flower for several years together. Between these two extremes there are intermediate degrees, including the greater number of our arborescent species. Greater frequency of seeding is obviously a marked advantage in the struggle for existence. Nevertheless, as we have already seen in the case of bamboos, great profuseness can more than make up for long intermittence, even where the associated species seed abundantly every year. It is obviously when the species concerned is shade-bearing, and able to push up through cover, that frequent seeding alone, without combined abundance, gives it an easy predominance.

The annual or intermitteut seeding of the various forest species is, of course, due to their nature. For instance, the bamboos will, under no circumstances, throw up flowering shoots every year in a general manner. But even with trees which produce inflorescence buds annually, the ravages of frost, drought, fire, insects, &c., will sometimes cause seed to fail. Such failure must be traced to the interval between the

appearance of the buds and their final change into ripe fruit. When this interval is long, successful seeding is exposed to all the fatal risks just enumerated. Thus between the appearance of the flower bud and the maturation of the cone of the deodar more than a whole year elapses, with the consequence that seed fails on an average in one year out of every four. Whereas the corresponding interval in the case of the companion firs, which ripen their cones at shorter intervals, does not exceed nine months, and the bursting forth of their buds, and the whole process of fructification, occurs between April and November of the same year, *i.e.*, during the mildest months. Similarly, teak near its northern limit in India, although it flowers abundantly every year, sometimes fails to form fruit owing to the heavy frosts of December and January. And so with *Terminalia tomentosa*, &c. On the other hand the entire activity of the inflorescence bud of sal is accomplished between March and the following June, so that, unless fires are so exceptionally severe as to scorch up every green thing in the crowns of the trees, or insects are exceptionally numerous and destructive, a certain quantity of seed must be produced every year.

Some species, like the *Hardwickia binata* for instance, produce flower-buds only in very dry years. Drought has also, no doubt, some influence on the flowering of bamboos, which frequently coincides with years of scarcity. And, indeed, drought may generally be said to favour the production of flower-buds by weakening and diminishing the foliage of the trees.

Frequency of seeding is also dependent on the density of the leaf-canopy, some trees, as already stated under (*a*), requiring a less degree of isolation than others to produce flowers and fruit. For instance, it is a matter of common experience in Assam to find isolated individuals of *Mesua ferrea* loaded with fruit, while the seed collector wastes his pains in canopied masses of that species.

(*c*). *Size and transportability of the seed.*—Large and heavy seeds like acorns will drop almost vertically on the ground, while the minute seeds of *Stephegyne*, *Adina*, *Andromeda*, &c., will be blown away to considerable distances by the slightest wind. But large and heavy seeds may, thanks to foliaceous or comaceous appendages, such as are found in teak, sal, *Pterocarpus Marsupium*, *Terminalia tomentosa*, &c., be carried some distance off from the parent tree by wind. When small or light seeds are armed with such appendages they may be blown away for miles; for instance, hundreds of thousands of young *Stereospermum suaveolens* will be found covering several square miles which do not contain a single fertile tree of that species. Then again water may transport seed over long distances, as is strikingly illustrated by tamarisk, babul,

sissoo, khair, cocoanuts, &c. Another interesting example of this may be quoted. The nearest limit of the region of *Anogeissus pendula*, from the northern boundary of British Nimar, is not less than 150 miles along the course of the Narbada and its tributaries; nevertheless the banks of that river, where it runs through the dry Vindhyan barrier north of Punasa, is covered in places with a dense low growth of that species, the outcome of seed brought down the river and arrested there.

But the transport of seed is facilitated not only by its lightness, or its appendages, or by water, but also by its edibility. Thus the heavy seed of the *Diospyros Melanoxylon* is disseminated far and wide by bears, jackals, men, &c., who are greedily fond of its sweet pulpy fruit. So with various species of *Zizyphus*, with *Gmelina arborea*, *Myrica sapida*, *Schleichera trijuga*, *Buchanania latifolia*, the sandalwood tree, wild pear, *Terminalia Bellerica*, babul, *Tetrantheras*, *Michelia Champaca*, &c. Birds are active distributors of the seeds of the various species of Ficus and *Loranthaceæ*, depositing them on their future hosts in places favorable for their reception.

(*d*). *Season of fall of seed.*—In forests where fires are an annual occurrence, seeds shed at any time before that plague has passed through, are bound to be almost wholly destroyed, only a few escaping which fall on bare ground clear of combustible substances, or which belong to species, like the teak for instance, the seed of which can stand a high degree of temperature without being killed. Species like the sal, eng, toon, *Tetranthera monopetala*, &c., the greater proportion of the seed of which falls at the beginning of the rains, when the season for fires is over and all nature is green and damp, possess a very marked advantage over their associates. The gregariousness of *Quercus dilatata* and *semecarpifolia* is to a great extent to be explained by the fact that their acorns ripen and fall in the middle of the rainy season.

And, in a general manner, it may be said that the longer the interval between the fall of the seed and the ensuing rainy season is, the less chance is there of finding a large proportion of it fit to germinate when that season arrives.

(*e*). *Relative vitality of the seed.*—This condition has a most important influence on the reproduction of a species. Teak, although its seed is shed when jungle fires are about to commence, and has to lie for several months on the ground, exposed to various causes of destruction before the first fall of rain, is still able to reproduce itself freely, thanks to the extraordinary vitality of its seed, which even a certain degree of scorching will not kill, and which remains perfectly sound after several years of exposure to alternate damp and drought in the forest. On the other hand, the seed of the *Terminalia tomentosa*, unless it finds moisture enough to germinate at the beginning of the very first rainy season, at once rots and dries

up. Small seeds, like those of *Anogeissus*, *Stephegyne*, *Adina*, &c., are killed in numbers simply by the heat of the sun during the hot weather, and but for that circumstance, those species would easily overrun, as the two *Anogeissus* actually often do, the whole forest wherever it grows. As regards the *Anogeissus pendula*, however, water seems to exercise a great preservative effect on its seed, which, as already mentioned above, is carried down by river more than 150 miles, to germinate where it is deposited. This peculiarity is also well illustrated by the production of new forests of sissoo, khair, tamarisk, and babul.

(*f.*) *Relative facility of germination.*—This condition has a very marked effect on the reproduction of the various species composing a crop. Thus in sal forest, there is every year a more or less plentiful new crop of seedlings of that species produced, whereas, save in exceptional years and places, yearlings of the allied species are either wanting or are entirely in the minority. This is due to the sal seed germinating as soon as it falls, while that of the other species, although many of them are annually fertile, germinate with much less facility. Teak, in spite of its profuse and generally annual seeding, nevertheless, as a rule, produces every year only a very small number of seedlings, owing not only to the early fall of its seed, but, throughout India proper, chiefly to the excessive difficulty with which it germinates, having often, under the most favorable circumstances, to lie in the soil for upwards of two years. There are other species, the actual germinative process of which spreads over several days, so that when once that process has begun, if a sudden prolonged break in the rains should occur, and the soil dry up at the surface under a hot sun, it must be immediately arrested and the germ killed. Such species are *Terminalia tomentosa*, *Gmelina arborea*, &c. Again, the same class of seeds, for the very reason that their germination is protracted, are also often liable to rot from temporary excess of moisture. But the most striking instance of superior germinative facility giving an infinitely great advantage to species that possess it, is that of the grasses: whence the extreme difficulty of restocking open treeless land.

X. RELATIVE FACILITY OF GROWING UP AGAIN FROM THE STOOL.—All broad-leaved species can grow up again from the stool. None of the conifers possess this faculty; the *Pinus longifolia* and deodar, it is true, do often shoot up again from *near* the base, but never really *from* the base, which latter property is the essential characteristic of stool-shoots. But among the broad-leaved species themselves not only does the age, up to which the power of growing up again from the stool is retained, vary with different species, but also the abundance of the shoots produced. Teak coppices very freely up to a

great age, often beyond a hundred years, and it is due chiefly to this property that it forms nearly pure crops of large extent in the mutilated forests of Central India, Berar, and Northern Bombay. Sal also coppices more vigorously than most, if not all, its companions, except perhaps bamboo, and is hence easily able to hold its own, notwithstanding that, as a rule, it is, with bamboo, the only species in the forests in which it occurs that falls under the axe of the wood-cutter. And so with a number of other species, to wit, khair, sissoo, willows, *Anogeissus*, jand, &c.

XI. RELATIVE FACILITY OF THROWING UP ROOT-SUCKERS.—The faculty of producing root-suckers is limited to a very small number of trees, but in revenge those which possess it have a permanent important advantage over their companions. This faculty is usually strengthened by any kind of mutilation of the aerial portion of the tree, being greater in proportion to the amount of the mutilation. Moreover, it is favoured by the wounding of the roots, suckers generally springing up from the edges of the wound. And, lastly, it is strongest in shallow, stony or rocky soils.

In Central India, *Ougeinia dalbergioides* forms large masses of pure forest on land recently abandoned by cultivation, the husbandry operations having helped to multiply the number of suckers from the original plants. The same, although to a much less degree, may be said of the *Diospyros Melanoxylon* in the same forest region. One of the main causes of the predominance of *Boswellia thurifera* in the dry forests of Central India is the facility with which it throws up suckers. The gregariousness of sissoo in Northern India is also in a great measure due to the same cause, as is also the invasive character of *Buchanania latifolia* in Northern and Central India, and of *Excœcaria sebifera* in the Dehra Dun.

XII. RELATIVE DURATION OF FOLIAGE, AND SEASON OF ITS FALL AND RENEWAL.—This condition influences to a very remarkable extent the distribution and proportion of many species in a crop. It is evident that, other circumstances being equal, the longer a species remains in leaf during the year, the better is it adapted to secure ultimate mastery over its companions. A tree in leaf is constantly assimilating new material for its growth, and either spreading itself out in every direction, or preparing to do so, the result being that it is able to steal a march on its leafless neighbours, and this with conspicuously greater effect if the season for the renewal of its foliage occurs earlier. Thus, where the climate and soil are suited to evergreen species, these always predominate over their deciduous companions (see Evergreen Forests in Chapter III). In some parts of Burma evergreen species have invaded the confines of teak, and surrounded in their close embrace isolated trees of that species, which will now be the

last of their race there. Again, the sal, which is all but an evergreen, is able to suppress most of its would-be rivals. Thus in the Raipur district of the Central Provinces it has encroached on the teak in many places. The *Anogeissus pendula* is leafless for a few days only in spring, and tolerates few companions of other species. On the other hand, the *Boswellia thurifera*, besides possessing an open crown, is leafless for from eight to nine months; so that, although for other and more potent reasons it does grow gregariously, it nevertheless allows other species not only to push up into the leaf-canopy on a level with itself, but also to occupy a permanent and often large place there. Such species are *Hardwickia binata*, *Anogeissus latifolia*, teak, khair, &c., which all retain their foliage for some months after the *Boswellia* has shed its own, and renew it from several weeks to several months earlier. Indeed, in many localities, the *Boswellia* may be looked upon only as a temporary natural crop to be replaced by more favoured species to which it is now acting as a nurse, and which will drive it out when they no longer require its protection.

The number of flushes of new leaves that a species brings out during the year is also an important factor for consideration. Every new flush of leaves is accompanied with a sudden outburst of both lateral and upward growth, during which the tree is able to push up against and through obstacles, against which it may at other times be completely powerless. The *Hardwickia* produces at least two such flushes every year, and hence its ability to beat species much more shade-bearing than itself.

Lastly, where late frosts occur, trees that bring out new leaves early in the year will naturally suffer more than others whose foliage-buds begin to swell up, preliminary to bursting forth, only after the frosts are past. *Abies dumosa* suffers in this manner; and thus also is explained the impossibility of acclimatising deodar and the Indian silver fir in Northern Europe.

XIII. GRADIENT.—The effect of gradient, when there is no impeding cause, is to drain off the moisture of the soil. Trees like sissoo, the tamarisk, &c., require a great deal of water in the soil, and hence can grow only where the ground slopes very moderately. Other species, like sal, require a less quantity of water and a more perfect drainage; hence their affecting only steep or rolling hill sides, except, when, as in the Bhabar, the soil itself lets water pass through it as through a sieve. A third class, like teak, requires still less moisture in the soil, but does not object to a less free drainage; hence its ability to grow both on hill sides or on gently sloping ground with less or more binding soil. A fourth class, like the *Pinus longifolia*, requires even less moisture in the soil than the preceding but the most perfect drainage, and will hence, where the soil itself is not freely permeable, confine itself to slopes with

a gradient of at least 30°. A fifth class, like some *Euphorbias*, objects altogether to any very appreciable quantity of moisture in the soil, and hence where the rainfall is at all plentiful, will grow only on scarps; and so on.

But with species growing on hill sides it is not simply a question of drainage. The species must also have roots adapted to hold on firmly to steep slopes, and hence of two trees, similar in every other respect, that one will possess a decided advantage which has the stronger and more firmly-seated roots. Moreover, species with horizontally spreading main roots will do better on slopes than on level ground, since there half their main roots will be able to penetrate into the hill side, whereas on level ground every such root will be superficial, *e.g.*, oaks, *Cupressus torulosa*, &c.

XIV. RELATIVE DEPTH TO WHICH THE ROOTS PENETRATE.—This condition has a most important bearing on the distribution of some of our most valuable species. For instance teak, the *Terminalias*, &c., spread out their roots within only six feet and often less of the surface, so that in shallow soils resting on a perfectly dry subsoil, they yield the place to *Boswellia*, *Anogeissus*, khair, *Prosopis spicigera*, &c. The *Prosopis spicigera* itself has been known to force its main roots down to 60 feet below the surface of the water, and is, accordingly, able to flourish in the dry plains of the Punjab, whither no other tree can follow it. Again the sal is almost the only tree that can grow on the waterless boulder deposit between the foot of the Himalayas and the Terai, known as the Bhabar, the roots of that species being able to penetrate to a depth of certainly more than 60 feet, which fact accounts for its generally forming much purer forests there than in the hills. Many of the trees of the dry tracts of India, which bring out their leaves in the depth of the hot weather, like the *Bassia latifolia*, *Buchanania latifolia*, &c., have been known to send down their dense network of fibrous rootlets 20 feet below the surface.

Limiting the consideration of this condition to the case of young seedlings, it may be laid down as a general rule that the longer the taproot developed by yearlings of a given species is, the better are they able, other things being equal, to resist both frost and drought, and, therefore, the more likely is that species to predominate over every other that may be associated with it in the same crop. Instances in point are sal, *Hardwickia*, &c. The long taproot of the *Terminalia tomentosa* yearling enables it to survive severe and prolonged drought, without, however, affecting the natural sensitiveness of that species to frost. The deeper any layer of the soil is, the less exposed is it to changes of temperature due to subaerial variations, and the larger the proportion of moisture in it. Hence the deeper a taproot goes down, the more likely is it to find sufficient moisture, and the higher will be the temperature of the moisture which it pumps

up into the plant portion above during frosty weather—the one circumstance being a protection to the plant against drought, the other against freezing. And besides this, as during frost the water contained in a certain thickness of the soil, which thickness varies with the severity of the frost and the character of the soil, freezes and expands, causing the soil to swell up several inches, seedlings with a short taproot rise with the soil, and are hence left ejected when the latter subsides on thaw occurring. On the other hand, seedlings with a long and strong taproot are safe against such a catastrophe, unless the taproot is torn asunder by the up rising of the superficial layers of the soil.

XV. RELATIVE QUANTITY AND SPREAD OF THE ROOTS (INCLUDING THE RHIZOME).—Some species develop a close matted mass of roots and rootlets, which strangle the roots of other species growing with them. Some again also possess abundant spreading underground stems. The roots and rhizomes of species of *Carex*, *Andropogon*, &c., form a felt-like mass, often several feet thick, which strangle out all other growth. Once bamboo has taken possession of the soil, few individuals of other species can force their roots through the dense tangled mass of its fibrous roots; and conversely when the soil and locality are both suited to the growth of bamboos, no individuals of species with superficial roots can co-exist with them, only such trees as can spread out their roots below the layer of the soil monopolised by the bamboo having a chance of struggling successfully for a place in the forest crop. Hence the frequent inability of teak, *Terminalia tomentosa*, and other species possessing more or less horizontally spreading roots to cope with bamboos, which cannot, however, keep out sal and other trees with deep-seated roots.

XVI. A CLIMBING HABIT.—Under condition III (*g*) we have explained how climbers, considered as an extraneous accident in a forest crop, kill or at least weaken trees, and thus *assist neighbouring trees* in gaining the victory in the struggle for existence. In this place, on the contrary, we are concerned with the struggle between the *climbing plants themselves*, considered as forming an integral portion of the forest crop and the trees on which they climb.

Plants with a climbing habit rise up into and spread over the crowns of their supports, either (i) by means of adventitious roots, which enter the very smallest crevices in the bark, and attach themselves firmly thereto, *e.g.*, ivy, *Ficus scandens*, &c.; or (ii) by means of tendrils, *e.g.*, the whole genus *Vitis*, many rattans, &c.; or (iii) by means of hooked spines, *e.g.*, many rattans, &c.; or (iv) by twining round the stems and branches of their supports, at first in a loose coil, and then with a tight grasp, *e.g. Millettia auriculata*, *Spatholobus Roxburghii*, *Bauhinia Vahlii*, *Butea superba*, and a host of

other climbers; or (v) and lastly, by interlacing branches with, or simply resting up against or on the stems and branches of, their supports, *e.g. Zizyphus rugulosa*, &c.

Whichever the mode of ascension followed, the result is always the invasion and overspreading of the crowns of the supports by the dense foliage of the climber. The least harm done is impeded growth, and a sickly condition of the support. Moreover, when the climber ascends by twining, the stems and branches of the supports get constricted, the increasing pressure on the bark, following the entire circumference of the stem, prevents the free vertical diffusion of the elaborated sap coming from the leaves and other green parts; and finally, the channel for the passage of the crude sap from the roots becomes disproportionately smaller and smaller for the nourishment of the crowns, which become, in consequence, scraggy, sickly, and full of dead twigs and branches (the cause of future interior decomposition), and, if the trees form a heartwood, there is ultimately no sapwood left in their trunks, and death from sheer inanition is the result.

As with all other plants, so with climbers, the immediate effect of light is to retard the development of their tissues; and hence all climbers exposed to full sunlight and wanting a support become low erect bushes, or at the most assume a straggling habit. With defective illumination stopping short of the minimum absolutely necessary for assimilation in each case, climbers will form long internodes, and extend themselves vigorously; and indeed the largest of them are found in dense evergreen forests. Taking the special case of twiners, we know that the nutating end of the stem has comparatively small leaves and long internodes, exactly as if they grew in weak light, and this character is no doubt the result of a habit still continued, although the inducing cause (*viz.*, deficient illumination) is absent. We know, besides, that all climbers are shade-bearing, for without this quality they could not, as we know they do, make their way through the very densest crowns, as well as develop an aggressive mass of leaves in the midst of the already abundant foliage of those crowns.

To sum up: Climbers, no matter how they ascend, are able, thanks to their being shade-bearing to a very remarkable degree, to rise up into, invade, and overspread the crowns of neighbouring trees, no matter how dense. They thereby not only prevent these latter from extending themselves either upwards or laterally, but reduce the quantity of their foliage, kill and prevent the development of twigs and young branches, and induce premature decay and death. They are most destructive, if they are also twiners.

(To be continued.)

E. E. FERNANDEZ.

The Cape Forests.

Report of the Superintendent of Woods and Forests, M. le Compte Vasselot de Regne.

(*Continued from page* 1.)

II.

South-east Region.

Divisions of Uitenhage and Port Elizabeth

The eastern part of the division of Humansdorp contains no Crown forests.

The same is to be said of the divisions of Uitenhage and Port Elizabeth through which we passed.

The Harbour Commissioners at the latter town are carrying out works for arresting the sands deposited by the sea from the east of the Bay.

Drift sands near Port Elizabeth.

This work, commenced by some French workmen, has succeeded in attaining the desired object. There is no doubt it would be possible, without any increase of expense, to utilize these sands so far as they have been arrested, and it would be as beneficial to the country as to the proprietors if something of the kind were done.

We then visited the division of Alexandria. The Crown forests here are principally situated on very dry ground, the soil and sub-soil of which are very permeable, and contain a growth of timber of very little demand in the country.

Division of Alexandria.

Nevertheless, the trees mostly possess, according to Dr. Pappe, some properties which should render them useful for a number of purposes.

Sneezewood enjoys exceptional favour, comparable to that of stinkwood, in the south-west district: thus it has become scarcer than even this last kind, preserved hitherto in the Tzitzikama, on account of the difficulty of reaching it. Prompt measures should be taken forthwith to prevent the complete disappearance of the sneezewood, and afterwards to assure its reproduction and increase.

Sneezewood.

The two principal forests, Olifants Hoek and Addo Bush, have not been surveyed. Their total area appears to be about 12,000 morgen, containing useful timber to the amount of 7,500,000 cubic feet, which should yield, annually, about 75,000 cubic feet.

Forests of Olifants, Hoek, and Addo Bush.

The Government, in allotting Crown lands in this locality, has reserved the timber, which is found there. The total area of these blocks is estimated at 6,200 morgen.

Crown lots reserved.

The most important are situated in the Zuurberg. It would be sufficient, probably, in order to introduce timber here, to prevent any felling for a certain defined period, and to scatter, before cutting down trees, certain well-prepared seeds adapted to the soil.

Zuurberg Lots: precautionary measures.

Lastly, it will be necessary to enclose the plantations in order to prevent injury to them by cattle.

The forests are looked after by a ranger, who does not appear to have any superior chief other than the Honourable the Commissioner.

I should here note the zeal and activity with which the present ranger, Mr. Nightingale, collected the information requested of him.

Nevertheless, the conservation is not carried out with sufficient efficiency, according to the present system.

There is an imperative necessity, before undertaking any improvements in this direction, for the presence, within a convenient distance, of an intelligent forest officer, capable of understanding the meaning, scope, and spirit of instructions which he would receive, and of being at the same time the counsellor, guide, assistant, and controller of the rangers of the province.

Superior forest officer recommended.

The forests of Alexandria produced in 1880, £273.

Yield of forests.

The total quantity of timber felled amounted to 26,120 cubic feet, and 273 loads of firewood.

Firewood industry.

This latter article has a substantial importance in this part on account of its proximity to Port Elizabeth.

The particulars of timber delivered, and the situation of the Crown lands of this division, are indicated in the annexed Tables.

The division of Albany possesses no Crown forests, properly so-called.

Division of Albany.

In terms of Section VIII, of the Crown Lands Act, No. 14 of 1878, and in all Government notices of the sale of lands under that Act, the lessee is prohibited from cutting any timber, trees, underwood, or bushwood, except such as shall be reasonably requisite for his personal use.

It would be absolutely necessary to specify the portions furnished with timber, and to verify their actual state, in order to make certain that this condition is observed.

Precautionary measures.

At the same time the question of introducing timber into these localities ought to be looked into.

Creation of forests in this Division.

Generally speaking, there is brushwood on the mountain sides although some of the hills are quite bare; but the summits of

the highest plateaux are absolutely destitute of timber of any kind; it is here, however, that trees would exercise the most salutary influence, and it appears certain they would succeed, judging by the splendid growths of the plantations around Grahamstown.

Grahamstown Plantations.

Maritime pine.

The maritime pine, especially, flourishes in a remarkable manner.

This species appears to accommodate itself with wonderful success to these dry and stony hill-sides, thrusting its roots into the fissures of the rocks, and developing into magnificent trees.

Division of King William's Town.

The Crown forests of King William's Town are situate at the north-west of the division, in the mountains of Pirie and Keiskama Hoek. They stand in a soil much less dry than that of the forests of Alexandria, and the trees attain very considerable dimensions. The species resemble more nearly those which compose the Knysna forests, but we saw no stinkwood or witte els.

Absence of stinkwood and witte els.

Yellow-wood used for sleepers.

Yellow-wood is much sought for. It is the only wood at present allowed to be supplied for railway sleepers.

The forests of this division have not been surveyed. Some licenses are granted for cutting timber and firewood, as also for taking saplings for the purpose of constructing huts and kraals.

Present supervision.

The staff charged with the administration of these forests is composed of Baron de Fin, Conservator, one head-ranger, and six subordinates. Correspondence with the chief office is conducted through the Civil Commissioner, who is called upon to give his advice upon forestry questions.

Objections to native rangers.

The Conservator states that the native rangers have not sufficient capability to perform the work which their duties demand. Their position among their tribes cannot fail to be a very delicate matter, when the interests of the forests are in opposition to those of their relations and friends, and especially when neither of them comprehends for a moment the utility of the measures which conflict with their interests.

Measures to be taken.

However this may be, the case is one pressing for attention, and particular heed should be paid to the following points:—

(1.) To accurately determine the situation of all Crown properties as fixed by law.

(2.) To draw up a valuation of the Crown forests, or, pending something better, at least an approximate one.

(3.) To take precautions against the danger of fire, such as are adopted in the Knysna, by keeping clear the borders of the forests.

(4.) To have rangers capable of preventing the young trees from being cut for the construction of huts and kraals.

(5.) To fix the seasons during which the various kinds of timber are fellable, and to disallow their being cut at any other, conformably to the Regulations of 1875.

(6.) To allow no herds or cattle to penetrate the forests, if it can be helped, or at least to prohibit their entering the districts where felling is taking place.

(7.) To watch carefully that the felling by contractors is not mixed with that of others who hold licenses.

In this district, more particularly than for that of Alexandria, the supervision of a superior overseer would be necessary.

Superior overseer recommended.

Such a task could hardly be imposed upon Baron de Fin, whose length of service, experience, and devotion, cannot be better utilized than at the locality itself of which he has the charge. It would be necessary to give him an assistant, who would fill the functions of second upper ranger for the portion of the forests nearest to Keiskama Hoek, now too far removed from the only existing head-ranger. This assistant should, at the same time, serve to ensure the carrying out of the forest regulations, and should also keep the books.

Above to be stationed at Keiskama Hoek.

A ranger resides near Stutterheim. In approaching this town, it is perceived that timber becomes rarer and rarer. In the east of the division there is none existing.

Division of Stutterheim.

The production of the forests managed by Baron de Fin, in 1880, was as follows:—

Yield of forests.

Timber ...	...	48,700 cubic feet.
Huts and kraals	...	184 loads.
Firewood	...	1,545 loads.

The total value amounted to £1,657.

The books of Baron de Fin, the Conservator, are very carefully kept.

From Stutterheim to Queenstown the country is absolutely devoid of timber.

Division of Queenstown.

A sum of £500 should be devoted to plantations at Cathcart.

Cathcart, plantations recommended at.

There exist no Crown forests in the division of Queenstown, but the Government possesses about 30,000 morgen of Crown lands, of which the larger part could, without doubt, produce trees if works

Creation of Crown forests.

for planting were carried out there. The soil has the reputation of being unusually fertile, and the scarcity of water is the only thing that the owners of the ground appear to dread.

Division of Stockenström.

The postal line from Queenstown to Fort Beaufort crosses the Crown forest of Katberg, in the division of Stockenström. The district through which this route winds is a steep mountain side, now desolated through having been burnt.

Effects of burnings.

Nature, alone, appears powerless to repair the waste occasioned. The land, still studded with trees, dry at their base, is overrun with bush and creepers, amongst which we could discover no natural sapling of a timber tree.

Here, as in the Division of King William's Town, the extent and contents, &c., of the forests have not been examined.

I drew the attention of the ranger, Mr. Atmore, to this absence of information on his part, and I showed him how he could determine approximately (until something better could be done) the extent and the value of the forests of which he has charge. He, with a zeal which I feel it my duty to record, explored the lots placed in his charge, and collected the particulars in the table annexed to this report, which show the apparent capability of the forests in the division of Stockenström.

Measures to be taken.

Undoubtedly, the first thing to be done on this point should be to define, as regards the Crown forests, the nature and extent of the rights reserved by the Government, and to decide as to how far it is practicable to enforce them.

Crown forests on native locations.

The Crown forests are spread amongst lands given as locations to the natives.

Reservations by Government, and extent of the obligations imposed by them.

The Act of Concession says: "The Government, reserving to itself all forest timber (if any), now growing, or being upon any part of the commonage of the location."

Does this reservation carry with it the obligation for the natives not to cut the young branches for their huts? Is there any obligation on their part not to allow their cattle to nibble the shoots?

Has Government power to sow or to plant in spaces devoid of trees, also in parts destroyed by fire; and to keep clear the borders of the forests in order to prevent fire, &c.?

These are all so many vital questions as regards the conservation of these woods.

Sneezewood has become very scarce.

We were told that a contractor had undertaken to supply 40,000 telegraph poles for a line beyond the colony. Is it expedient to exhaust our colonial forests for the sake of supplying to another State wood required for own needs?

Sneezewood: Contract for supply of telegraph poles to another State.

The superintendence of the forests in this division is entrusted to two rangers. The chief ranger has no superior chief upon forestry matters, other than the Commissioner of Crown lands. He is absolutely isolated in the country, without assistance, advice, or control.

Present supervision.

Can he anticipate eventual difficulties, or prevent that which is unavoidable?

Has he even sufficient preliminary ideas to enable him to grasp the origin of such questions, with their details and consequences? And to explain these points, and furnish useful advice upon them?

In this district, as well as at Alexandria and King William's Town, the experience of a superior forestry officer would be indispensable.

Necessity for experienced forestry officer.

Yield of forests. This district produced in 1880 :—

Timber ...	...	70,000 cubic feet.
Firewood	...	72 loads.

The total value of its proceeds amounted to £1,271.

The white ironwood is as much sought for as yellow-wood or assegai.

White ironwood.

The particulars of these products are given in the Table below :—

Yellow-wood. Cubic feet.	Iron-wood. Cubic feet.	Assegai-wood. Cubic feet.	Red pear. Cubic feet.	Poles. Pieces.	Spar. Running feet.	Firewood. Loads.
13,500	15,800	17,200	7,200	3,277 cubic feet. 16,027	12,750	72

In the division of Victoria East, bordering on that of Stockenström, is found the forest of Tyumie, adjoining those of the division of King William's Town.

Division of Victoria East Tyumie forest.

A contractor is at present preparing sleepers there. The contract, to be executed during the years 1880 to 1885, is for the supply of 60,000

Contract for yellow-wood sleepers.

sleepers of yellow-wood. Ten thousand have been delivered, and 3,000 are prepared.

Dispute between native ranger and the Contractor.

At present there exists a difference of opinion between the native ranger, supervising the preparation, and the contractor, with regard to a lot finished.

The contractor has made, at his own expense, a road for getting out the timber from a mountain side, previously inaccessible, and the entire forest does not appear to contain much more yellow-wood than the quantity necessary for the execution of his contract.

In the meantime, other licenses are being issued, and the contractor does not fail to grumble sometimes, at seeing the road which he has opened used and worn out by other persons, for the purpose of carrying off trees upon which he himself had reckoned. Besides, the residents in the country see with anxiety all the timber of the forest disappear and carried off for sleepers.

The ranger is under the orders of the Civil Commissioner of Alice.

The forest of Tyumie is, for soil, temperature, contents, and the treatment it undergoes, in a position similar to that of neighbouring regions.

Between Seymour and Fort Beaufort we observed in the mountain, on the right, some private forests, and the forest of Mancazana on the left. The country is covered with massy *Acacia horrida*, improperly called here "Mimosa."

Private forests.

Fort Beaufort possesses some timber belonging to the Government. The Civil Commissioner issues licenses for felling, and his first clerk is deputed to measure it as it is cut.

Between Fort Beaufort and Bedford, we passed by Yellow-Wood, a place so called on account of the quantity of timber of this kind which was formerly found there. It is now remembered in name only.

"Yellow-wood" near Fort Beaufort.

On the north-west of Bedford, on the south side of the mountain, there is still to be seen the residue of a private forest; the timber which it contained has been almost entirely cut down. From Bedford to Graaff-Reinet, the thickets occupy fewer large surfaces, and the country becomes drier.

III.

Western Districts.

Nothing is comparable, however, in respect of dryness, to the district known as the Karoo, which extends southward of the line from Graaff-Reinet to Beaufort, West. There are no more mimosa thickets. The clumps of flowering shrubs, instead of forming green swards, are scattered far apart.

Western districts.

The Karoo.

Saline eruptions, &c.

In a great many places saline eruptions appear on the surface of the soil, and we find much vegetable growth peculiar to the seashore.

Dryness of rivers.

The rivers overflow when it rains, and subside soon after, in such a manner that, during more than 300 days in the year, the beds are to be seen dried up.

Division of Beaufort, West.

Beaufort dam.

At Beaufort itself, the inconvenience of long intervals between the rainy days, has been remedied by the construction of a dam enclosing a large reservoir. By this arrangement, a large quantity of water, which would otherwise run uselessly to the sea, is shut up and stored for the use of the town for irrigation and other purposes.

Some plantations have been commenced here.

Experimental Garden at Beaufort, West. Mr. Clark's experience.

Mr. Clark, Superintendent of the Public Experimental Garden, thus describes his efforts :—

"I tried in vain for three years to grow some blue gums. This soil is brackish; the seed that I put in produced no results, and everyone here predicted that I would never raise a tree. I brought soils from neighbouring farms, tried them, and found some in which the seed produced very fine plants.

"I noticed that the brackish soil formed a superficial bed, not very deep, and by planting so that the trees had their roots below the saline layer, and by keeping them watered, the results, which are now seen, were obtained."

Success of Mr. Clark with blue gum trees.

We saw, in fact, very fine blue gums of two and a half years old, presenting every sign of a resplendent growth. It is truly fortunate for this district that the first attempts have been entrusted to an intelligent observer, who most earnestly desired to succeed in his work, and laboured with a perseverance that no discouragement could daunt.

Projected irrigation.

A reservoir is now about to be constructed, which will allow of an extent of 50 morgen being irrigated, on which plantations will be made.

Anticipated influence of plantation on climate.

It is to be hoped that these plantations will not be without exercising, ere long, some influence on the local climate.

However, I think that plantations of woodlands at a convenient height on the mountains in this region would be possible, and would have a beneficial effect.

From Beaufort to Cape Town the extensive plains of the Karoo are traversed.

Soil of the Karoo, its needs and its capabilities.

The soil of this stony desert is generally of a faultless quality, and the country wants only a supply of moisture proportionate to its needs in order to become, without doubt, one of the most fertile tracts in the world.

Worcester Wellington, and the Paarl.

Next come the rich districts of Worcester, Wellington, and the Paarl, which would undoubtedly, however, gain much by the replanting of their hills.

The Cape Flats.

Lastly, the Cape Flats are reached, vast sandy tracts, of which a considerable extent belongs to the Crown.

Visit of inspection.

I made a special visit to these lands on the 14th of September, accompanied by Mr. Lister, the Superintendent of Plantations.

The Surveyor-General was also good enough to join us on the first visit, and gave me particulars of his personal experience of the place, so far as the necessities of his own duty had allowed him opportunities for collecting them.

Success of pines in certain parts of Cape Flats.

The species of pines scattered in the district grow well in certain spots on the Flats. Near many dwellings, clusters of these old trees are to be seen, having attained a great height, and proportional size; and on the sides even of the railway we passed by young plantations in a good growing condition. On other parts of the Flats, they appear quite the reverse; they start, they vegetate during two or three years, attaining the second year less vigour than the first, and the third they fall into a state more or less sickly, until their weakness and decay is complete.

Singular decay of them in others.

Sandy soil of the Flats, how fixed.

The Flats comprise shifting sands, and sands fixed by vegetable growth.

Utilisation of Cape Town sweepings.

The plantations on the shifting sands were originally made by fixing in the ground lines of brushwood, and by sowing under the shelter of these bushes. In many places the success arrived at leaves much to be desired. The plan has been tried of utilizing the rubbish from the town, and by this means Mr. Lister has obtained very good results, especially in the valleys between the dunes, and better still around them.

Remarks on the wattle.

He uses generally the wattle (*Acacia falcata*) in these plantations.

The bark of this tree is much in demand for tanning, and the wood itself furnishes good firewood, but it does not acquire dimensions suitable for timber purposes. This reason, as well as other points in connection with the cultivation of these trees, renders it desirable to supplement them with other kinds.

The blue gum has been tried, but without much success. Resinous trees, whose tough leaves offer a better resistance to the winds and to other accidents of climate, should be tried in preference, and there is every hope that some other species would accommodate themselves to the soil, judging by the spontaneous presence of *Sapree* wood in the midst of new plantations.

Species of trees most suitable for these Flats.

It would be well to analyse these sands as soon as possible, in order to ascertain their elements, and then further researches could be made.

Analysis of the sands of the Cape Flats.

Mr. Lister, the Superintendent of Plantations, has already fixed and planted about 400 morgen. He estimates the extent which remains to be fixed and planted at about 24 square miles.

Planting already done.

In 1881 he commenced to sell the products, the receipts for which during the year 1880-81 amounted to £381 3*s*. 6*d*., and he has hopes that they will increase yearly.

Receipts from Cape Flats in 1881.

The work of actively fixing these Flats should be continued, and thus enhance their value. Nothing could be more useful for the district, or present better chances of being productive. The manner in which these works have progressed under Mr. Lister's direction should inspire entire confidence in the ultimate success of the scheme.

Continuation and extension of the planting.

There exist no exact data of the extent of the Crown forests situate outside the district of the Knysna, but from what I have seen I am persuaded that the forests of the three divisions of George, in Knysna, and the Mossel Bay, represent very much in extent, and especially in material, more than half the resources of the colony. Until we obtain full information, we will assume that there should be 100,000 morgen of Crown forests, affording a productive material of 50,000,000 cubic feet, or say an annual yield of 600,000 cubic feet of timber of every kind.

Crown forests in George, Knysna, and Mossel Bay, extent of &c, annual yield and value, &c.

The stock of old trees of secondary species is less than 10,000,000 cubic feet.

Trees of secondary value.

It might be advantageous to use this superabundant material, the accumulations of centuries, and it is certainly necessary to free the forests of it, proceeding carefully, cautiously, and steadily.

Disposal of superfluous timber.

Treated in a reasonable manner, the Crown forests should produce, annually, at least 3,000,000 cubic feet of useful wood.

Annual yield of useful timber that should be available.

Private forests, attacked by the axe and fire, are on the road to a rapid detimbering. They do not cover more than 20,000 morgen, and they do not

Private forests, disappearance of.

contain timber to any appreciable quantity, except in those parts which have been recently sold.

Bush lands, extent and produce of.

The extent of bush land is even more uncertain. Regard being had to the positions they occupy, and referring to such information as I have gathered, I think that their extent may be estimated at nine times that of the forests, say 1,080,000 morgen. Thus 12,000 morgen producing timber, 1,080,000 morgen of brushwood, suitable for firewood, in all, say 1,200,000 morgen.*

Total yield of timber and firewood.

Besides the above, there are timber in certain kloofs in portions of the divisions of Namaqualand, Calvinia, and along the Orange river, described in the map of 1876, containing a large forest of aloe trees.

PART II.—*Requirements of the Colony.*

I.

CONSUMPTION.

Let us see now what are the requirements of the colony.

Consumption in 1880.

The total consumption of timber in 1880 amounted to—

"Colonial," approximately	...	250,000	cubic feet.
Entered for consumption	...	2,014,313	„
		2,264,313	„

Let us endeavour to summarise the needs that were satisfied.

In 1875 there were in the colony 55,212 houses.

Timber used for construction of buildings, &c.

Admitting that there are in it at present 60,000 houses, supposing a house to last fifty years, a number equal to 1,200 houses would be annually either entirely rebuilt or partially so; that is, reckoning 20 houses to each district.

If the average quantity of timber used in a house is 600 cubic feet, to meet this demand we should require 720,000 cubic feet.

The quantity employed in absolutely new constructions would be at least as large, and we should hope that it would rapidly increase, as this would be the most certain sign of the development of the country.

Total quantity used for construction of buildings, &c.

The consumption of timber used for construction may, I think, be estimated, in all, at 1,500,000 cubic feet.

In 1875 the colony possessed 421,762 draught cattle. Sup-

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* From information which the Surveyor-General has been good enough to furnish, it appears there is a large tract of forest between the divisions of Uitenhage, Alexandria, and Somerset, known as the Addo Bush, but this tract is unsurveyed. Believed to be chiefly high bush and forests (unsurveyed), occupying a surface of about 100,000 morgen.

Unsurveyed forest lands.

Timber used in manufacture of vehicles, &c.

posing one wagon to require 16 of these animals, and deducting, say, 5,762 head, we should have, in round numbers, 26,000 wagons.

Besides oxen there were 235,000 horses and mules. Admitting that half of them would be employed for the saddle alone, and allowing for the remainder a vehicle for every four head, this would give 29,000 conveyances, into the construction of each of which there enters one-third of the wood necessary for building a wagon. We should, therefore, find employment for a quantity of material equivalent to that of 9,000 wagons; or, taken together, equivalent to 35,000 wagons. Allowing that a wagon is renewed entirely or partially every twenty years, the consumption is then represented by the quantity which would enter into the yearly construction of 1,700 wagons, say 170,000 cubic feet; and, reckoning waste, 200,000 cubic feet would be the bulk of timber consumed in this manufacture.

Total quantity used in manufacture of vehicles, &c.

For this purpose 1,700,000 cubic feet would be employed.

Balance of timber, how accounted for.

The remainder of 564,313 is doubtless used in the manufacture of furniture fustage, enclosures or fences, ship-building, &c., and employed by the Public Works Department in harbour works, ponts, sleepers, and telegraph poles.

Sleepers and telegraph poles; number cut in 1880.

In the year 1880 only 12,000 sleepers, and from 4,000 to 5,000 telegraph poles, were cut in the Crown forests, but these two products demand a special notice.

Sleepers for railways, present and future.

The construction of each mile of railway necessitates the use of 2,000 sleepers, including those requisite for shuntings and sidings.

There are open at present in the colony nearly 1,000 miles of railway, for the equipment of which 2,000,000 sleepers, equivalent to 4,000,000 cubic feet, are required. The life of these sleepers averages ten years.

The maintenance of the sections now open requires yearly 200,000 sleepers, equivalent to 400,000 cubic feet. The network of railways in the colony may possibly be extended by another 1,000 miles.

The construction of this extension will require 2,000,000 sleepers, equivalent to 4,000,000 cubic feet, exclusive of the wood required for railway buildings, station yards, and stores. The yearly maintenance of the new lines will absorb 200,000 sleepers, and the annual consumption will be raised to 400,000 sleepers, or 800,000 cubic feet.

The railways will, therefore, absorb—

For original equipment, 2,000,000 sleepers, or 4,000,000 cubic feet.

For annual maintenance, 400,000 sleepers, or 800,000 cubic feet. And, in view of this fact, the annual consumption of timber will be increased by 800,000 cubic feet.

As a matter of fact, the stage of maintenance has scarcely yet been arrived at; and, as I have previously stated, the quantity supplied during this year has reached the insignificant total of only 12,000 sleepers.

Sleeper contracts.

There are at present, to my knowledge, four contracts in operation for the supply of sleepers. They are being carried on in the forests of the divisions mentioned below, and are intended to supply the quantities indicated:—

Knysna	...	...	500,000
Do.	...	...	25,000
King William's Town		...	60,000
Victoria, East	...	...	60,000
Total	...	...	645,000

Telegraphs.

There are at present 3,140 miles of telegraph lines open. It is probable that the system will ultimately represent a development much more than double its present extent.

Poles for telegraph lines.

The poles necessary for the construction of the new lines, and for the maintenance of the entire system, will create a demand of very considerable magnitude.

Future annual consumption of timber for railway and telegraph lines.

The annual consumption of timber in the colony will then be certainly enlarged by a million cubic feet for these two services, and it is to be hoped that it will be augmented still more on account of the increasing development of the population.

Pecuniary saving, &c., in use of colonial timber for sleepers.

The manufacture of sleepers in the colonial forests represents a saving of at least six pence per sleeper; and an annual saving of 200,000 shillings, say £10,000, is not to be despised.

This saving will, I think, become much larger when we have made the necessary improvements. But even if there were no saving in the cost, we ought still to give the preference to the colonial productions, because their preparation, by giving employment to a large number of workmen, tends to the increase and well-being of the population of that portion of the colony.

Crown forests cannot supply present needs.

It is thus evident that the Crown forests, as at present worked, would be perfectly incapable of supplying the wants of the country, even with its present small population.

Stink wood; supply and demand.

These needs are now partially satisfied by importation, but the eagerness with which stink wood is sought for proves that this species is not cultivated so much as it should be, and trade suffers by reason of its extreme scarcity. This is a state of things to be improved upon, because, where there are no reasons for restricting production in a district in order to grow something still more valuable, it is better to produce than to import.

The production of this raw material at a rate cheaper than that at which it can be imported, would certainly be very beneficial to the trade of the country. An industry is often more seriously shackled than one thinks by the manufacturer not having at his door the raw material for the orders he receives; and it is always encouraged by facilitating the means of procuring the raw material.

Private forests not to be depended upon for supplies.

In the matter of forests we cannot rely upon the uncertain arrangements of private interests for the supply of our needs.

Reasons for above.

Again, into the production of timber there enters the element naturally vexatious in relation to supply and demand, namely, the question of *time*. Thus, in view of an order in hand for timber, where is there a speculator who would consider it worth his while to engage to execute an order deliverable within a century?

If the price of timber is low, it is to the owner's interest to clear his land for the purpose of substituting something that pays better. On the other hand, if the market is bare of timber, the price is consequently high, and he is then tempted to fell in a reckless manner.*

Ordinances against exterminating forests in France.

In order to preserve the forests [of France] a series of legislative enactments has been framed, which go as far as decreeing the penalty of death against those who grub up, without authority, even private forests.†

But laws against the extermination of forests have never proved effectual in preventing such operations when the owner found the latter to conduce to his advantage; and the long list of successive Royal Ordinances and Parliamentary Statutes starting from the time of Charlemagne, and coming down to the present day, has but served to exemplify the powerlessness of the law in this respect.‡

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* In the plains of Languedoc, near the mountains of the Alps, the inhabitants grub up even the roots. It would be a good speculation to plant trees in those parts, but it would be fifteen or twenty years before any benefit would be derived from them, and life is too short.—G. HURIOT.

† Edict of Louis XV. against exterminators of forests.

‡ Clave, "Etudes sur l'economie forestiere."

Future potential yield of our Crown forests.

The improvements which the Crown forests of this colony admit of should raise their production of timber to the level of the present consumption, and increase it by well-conceived plantations, whose sites will not usurp the place of more important works, and will, at the same time, insure an increase of production commensurate with the augmented consumption which the future of the colony appears to promise.

II.

Influence of Forests on Climate.

Influence of forests on climate.

The observations which we have been bringing to notice, whatever may be their weight, do not touch upon the most important aspect of the question.

Timber is, doubtless, a primarily indispensable article; although when we do not produce it we can, as at present, procure it from elsewhere, not always, however, without some disadvantages; since when the time arrives that our stock of stinkwood or sneezewood is exhausted, and it becomes necessary to substitute for these woods imported oak or teak, the cost will be found very great. At any rate we could but partially substitute for it other kinds, and the industries which use the former would either perish or dwindle away.

Possible interruption of extra-colonial supplies.

Further, what would be the result if foreign complications arose to disturb the markets of supply? Or what would happen should the ocean transport be interrupted?

We will proceed, however, to the main point.

Storage of rainfall.

The colony possesses very extensive territories, which require an enormous annual rainfall.

It is, in the highest degree, requisite that the rains, instead of collecting instantaneously on their way to the sea during the twenty-four or forty-eight hours succeeding their fall, should be intercepted, in order to preserve the coolness of the soil for as long a time as possible; and that they should be absorbed to enable them to re-appear afterwards, at various spots, in the form of perpetually-flowing streams.

Partial destruction of forests in France, and its results.

Now forests do unquestionably exert considerable influence upon the climate, and upon the conditions of the water-supply of a country. Up to the year 1865, we have been dwelling upon, as a whole, the climatic and hydrological facts which followed upon the destruction of the forests—facts proved in every country of the world as yielding a sufficient explanation of those phenomena. At this period, however, the French Government proposed to alienate a portion of the State forests in

order to apply the products of the sales to the execution of works of public utility. It proposed, in a word, to substitute for forests, canals, roads, and railways. What prospect could be more enticing to the public?

However, the *savants* remember the consequences of the destruction of the forests.*

The Government then tried to find other causes for the effects indicated, and endeavoured to remove from the forests the stigma attached to them on account of these phenomena. But the great majority of the *savants* did not find these explanations tenable, and preferred to wait longer for the realization of their ardent desires than, by killing the goose for the sake of the golden eggs, to risk the fertility of the country in order to obtain these benefits as soon as possible. The field was thus opened to scientific research on the subject. Observing stations were established, at which the results of the examinations were analysed and investigated; so that there are now the elements for establishing, in a synthetical manner, that which could be given, at the time when the subject was mooted, as only a proof by induction.

Establishment of observing stations in the French forests.

Explanation of action of forests.

The following is a *résumé* of the data collected:—

1. A comparison of the various thermometrical observations shows that the temperature of a given district is lower within than around the forest. This difference, almost *nil* in winter, is raised more than five degrees in summer. During the hottest season of the year the moisture from the forests ascends to the air-currents above them. These currents cause the temperature to be lower than is the case in connection with those hovering at the same height, above portions of the soil that are not wooded.

Thermometrical observations.

2. Hygrometric observations prove that in forests, in their vicinity, and principally above them, the atmosphere is more charged with moisture than it is in districts removed from them, all other circumstances being otherwise equal. M. Tissandier discovered, during an aerostatic voyage, that when the balloon was travelling over a forest the hygrometer rose with extreme rapidity, but descended as soon as the forest was passed.†

Hygrometrical observations.

3. Observations of the rain-gauge prove—

Raingauge observations.

(*a.*) That there falls in forests, and within the radius of their influence, a larger quantity of rain than on similar districts deprived of timber.

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* M. Becquerel, among others, in his report of the proceedings of the "Academie des Sciences," at its meeting of 22nd May, 1865.

† "Academie des Sciences," 10th October, 1860.

(*b.*) That the higher the situation of the woods the more sensibly is this influence felt.

(*c.*) That the foliage of trees intercepts an amount of rain varying from 8·5 to 52 per cent.

Atmometric observations.

4. Atmometric observations prove that evaporation is from six to seven times less within the forests than beyond them, and three times less from parts surrounded by wood than from ground absolutely open. Evaporation from agricultural soils is at least 70 per cent. of the amount of rain received by them.

Humus, or mould and its absorbing powers.

5. There is found in forests, under a bed of dead leaves not yet decayed, a layer of *humus*, or mould, formed by the decomposition of the leaves and the crushed vegetable matter previously accumulated and already rotting in the soil. The property of absorption possessed by this *humus* is about eight times greater than that of the various* limy soils, and from 2½ to 5 times greater than that of the different clayey soils.† The presence of mould on a soil, combined with the action of the roots of trees, augments the permeability of underlying strata, the least favoured in this respect.

Forests prevent gathering of torrents.

6. Forests, by reason of the rains which they attract, prevent the sudden gathering of rushing torrents.

It therefore follows:—

Effects of the action of forests.

That forests are vast condensing apparatuses, favouring or inducing the formation of rain and dew.

This influence of the forests was known long before any one had dreamt of determining it by natural experiment.

Proofs of the above.

We shall proceed to cite in support of this assertion certain facts proved no less in the colonial territory than in the countries which most nearly resemble it in all geographical respects.

Cape Colony.

Cape Colony.—"He" (Conservator of Crown forests at the Knysna) "mentions that during the severe drought in 1873 both the Tzitzikama and Knysna forests were visited by frequent showers, which rarely travelled beyond the forests."

"The immunity which British Kaffraria enjoys from the droughts so common in South Africa is believed to be due to the influence of the forests."

Natal.

Natal.—"As regards the meteorological influence of forests, the heavy timber lands have been observed to be the great condensers of vapour."

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* Calcareous.

† According to Schubler and Boussingault.

Mauritius. *Mauritius.*—"It is pretty generally believed that the destruction of the forests has had considerable effects upon the climate, and that, owing to the same cause, the floods are much more sudden and destructive than formerly. Many streams which never failed whilst their sources were shaded by the forests are now dried up."

St. Helena. *St. Helena.*—"St. Helena seems to afford a somewhat striking example of the effect of forests denudation upon climate. It is stated that the extirpation of the indigenous trees, shortly after the first colonization of the island in 1673, was followed by a succession of severe and destructive droughts, but that since the forest lands were replanted, the island has ceased to suffer from them to anything like the same extent."*

Egypt: rainfall induced by planting trees. Among a thousand other historical facts we will mention the following:—The dryness of the climate of Egypt is such that it never rains in Upper Egypt; and in the Delta, in former times, not more than five or six days of rain annually could be depended upon. The Viceroy, Mehemet Ali, planted, at one period, 20,000,000 of trees on this same delta. Some years after, when these trees had grown lofty, the number of rainy days increased to 45 or 46 annually.†

Springs influenced by forests. As wooded soils absorb more water than others do, the presence of forests must exercise a considerable influence on springs. Instances of this influence recur perpetually.

At Ascension. For example, the water source of the island of Ascension was exhausted by reason of detimbering, but the water returned when the mountain was replanted.

At the Grande Combe. Mr. Bean, Engineer of the Grande Combe, has established the following facts: The Company to which he was attached planted a forest of 850 hectares (about 1,000 morgen), and as soon as a portion of the plantation became advanced enough to deserve the title of "a wood," an old spring, which formerly with difficulty supplied in the heat of summer, two steam engines, yielded sufficient to feed these two engines, while its working power was more than doubled.

In the second place, the streams of this basin, during heavy rains, are not subject to such constant and violent floods as before, and the water runs slower and *for a much longer time.*

3. Forests, whether by influencing the number of days of rain, or by retaining rains for a longer period in the regions which receive them, or by favouring the feeding of springs,

* Analysis of returns in reply to queries relating to Colonial Timber, 1878, pp. 8, 9, 21, 37.

† Report on Rains and Forests, 1868.—Evidence of M. Pouchet.

and probably by exercising these reciprocal functions, have a marked and beneficial influence upon the rainfall of a country, and consequently upon its fertility.

In this regard, coincident facts are still more numerous.*

We will cite the most recent and the most common.

Forest influence on the waters of Lake Tagarigua.

The rivers which water the valley of Aragua, in the province of Venezuela, form, in their confluence, the Lake of Tagarigua, and have no other outlet. Humboldt, when visiting that country at the commencement of this century, ascertained that there was a gradual subsidence of the water-level of the lake. When, in 1822, Boussingault explored the country, he learned that the water had risen considerably. The forests had taken possession, during the same period, of a large tract of country in which the population had been decimated by the war of independence. They had developed there with that wonderful activity of vegetation which characterises the growth of trees under a tropical sun; and the rise of the water corresponded with the retimbering of the basin.

Subsidence of water-level of German rivers owing to disafforesting.

From a communication made by M. Counsellor Wex to the Geographical Society of Vienna, it appears that, since the extensive detimbering which has taken place during a period of fifty years, the mean level of the Elbe has fallen 17 inches; that of the Oder 17 inches; that of the Rhine 24 inches; that of the Vistula 26 inches; and finally, that of the Danube, at Orsova, 55 inches. At the same time a very sensible diminution of all sources of supply was found to have occurred.

Austrian Hydrotechnical Commission's reasons for the above.

The Hydrotechnical Commission appointed by the Austrian Engineers, for the purpose of examining into these facts, was unanimous in declaring that *the primary cause of the very disastrous decrease of the waters is due to the devastation of the forests.*†

Khanate of Bokhara made arid through disafforesting.

Twenty years ago the Khanate of Bokhara was one of the most fertile regions in Asia. This well-wooded and well-watered country, nourished by numerous streams, was a veritable terrestrial paradise. During the last 25 years all the woods have been cut down, and the few trees which remained were consumed by fire during a civil war. It was not long before the consequences began to be felt. The result was the complete transformation of the country into an arid desert. The streams dried up; the canals, excavated in olden times for irrigation purposes, are perfectly empty. The shifting sands of the desert, being no longer held in check by the barriers

* Becquerel on Forests and their Influence on Climates.

† Report on Rivers and Forests, 1875, p. 280.

formed by the forests, are gaining on the soil every day, and will eventually invade the Khanate in every direction, and transform it into a desert as arid as that which now divides it from Khiva.*

Humboldt on consequences of disafforesting.

This example entirely justifies the weighty words of the illustrious Humboldt—

"By felling trees which are adapted to the soil of the sides and summits of mountains, men, *in every climate*, prepare for future generations two calamities at once—want of firewood and scarcity of water."

Forest influence on torrents and on mountain sides.

4. Forests exercise an important influence upon torrents of water.

They preserve the soil on the mountain sides by maintaining the vegetation, and they protect the beds of large rivers from the encroachments or silting up which obstruct the mouths of those rivers. These facts have never been disputed. The results of twenty years of labour, crowned with constant success, confirm them to-day.

Forest influence on river beds and embouchures.

(*To be continued.*)

Mochras—an exudation from the bark of Bombax malabaricum.

DEAR SIR,—An inquiry was some few years ago set on foot by the India Museum regarding this substance, which is very curious. I collected specimens and sent them with a long note to Dr. Cooke, but have since heard nothing further on the subject.

The drug collections in the Panjab Exhibition of 1864, and also many local lists of drugs, gums, &c., contained entries of "mochras" (variously written mūcharas, mocherus, mocheras, &c.) The question was, what was the origin, nature, and use of the substance. It was confused (or identified) in some cases with what was called "phūl-supyárí" (=flower of the areca palm) though this was not a flower but a brown dry leathery kind of blister. But evidently the common mochras was not the product of the areca palm, which is unknown in the Panjab. This however would not be conclusive, because the substance may be imported. Will some officer in BENGAL or BURMA kindly enquire whether the areca palm yields any *gall* or astringent *gum*, or even an astringent *flower-bud?*

"Mochras" was usually assigned to the sembal tree (*Bombax malabaricum*) as its origin. In appearance it is what I have described, pieces of dry leathery but rather brittle, dark brown

* Report on Woods and Forests, 1876, p. 93.

substance, looking exactly as if a hollow blister of some material had formed on the surface of the bark, had dried there, and been broken off.

In my garden at Lahore there are two large and well grown Bombax trees, which must be as old as the very earliest British resident who came to Lahore, if not earlier. They are certainly planted, because though they do well in the good sailaba soil, they are not indigenous to the soil within a few miles of the river Ravi. I detached bits of the bark from one of these trees, made incisions, cut into the surface only, and down to the sapwood, and into the sapwood, but no gum or any other exudation of any kind appeared. But the other tree, which divides into two stems at about eight or ten feet from the ground, is covered, as to its lower part, with a clustering mass of the lovely "pink coral creeper" (*Antigonum leptopus*). Having occasion to trim this, and remove the old dry stems or bine, I disclosed the surface of the tree, and saw that close to the fork of the two branches, the stem was somewhat swelled, the bark was all broken up and excoriated, as if in fact a large sort of unhealthy swelling sore was there: a mass of brownish or blackish powder, or rather friable grains, had also fallen and collected at the foot of the tree. This residue looked rather like the excreta of some insects boring into the bark, but I could not detect any trace whatever of any bark-eating insects, or any *aphides*, &c. A great deal of this powdery stuff was to be brushed off the wood itself, seeming to come from the disintegration of the bark over the "sore." From all parts of this sore I found great masses of the "mochras" which had exuded and dried there; much of it was old and partly rotten, but some that was fresh looked like deep brown bubbles or shells that had irregularly contracted in drying. I cleared away all the powder, and picking of the best bits of mochras to go to Dr. Cooke, I cleared away the old rotten stuff. After some days I observed new mochras form; to my surprise it issued in various shaped masses, or worm-like pieces, as if one squeezed oil paint out of a tube; this gradually curled up or coagulated into a mass as chance would have it. It consisted of a rather firm slightly translucent dirty whitish yellow jelly.

To the taste it was almost insipid, but with a slight roughness indicating astringency. It proved wholly insoluble in cold water, and nearly so in boiling water, though I think it went into a pulp under such treatment. It did not appear either, soluble in pure spirits of wine, but imparted a red color to the liquid.

This jelly, when dried by the air and heat of the sun, acquired a dark brown color; the surface dried first, and the inner part gradually shrunk afterwards, accounting for the blister-like irregular pieces. This then is mochras (at least one kind of it).

But what is its nature, and under what causation is it produced? It seems to be of no use except for its astringent property, the native drug collectors having taken it as a "gall" (which it is not.)*

Perhaps some of your readers can add to our information about this substance, and also clear up the question what is phūl-supyárí of the areca palm?

The native writers evidently confuse the two things, because the author of the "Makhzan-ul-adwiya" says that mochras is the bud of the *areca palm*, but Hakim Ahsan Ali says that it is the exudation of sembal (*Bombax*.)

From Gurgaon I also obtained "phūl-supyárí" just like my "mochras," and the druggist declared they were one and the same thing; but still as a local druggist of Delhi insisted that he got *his* mochras from "purb" (Bengal, the East generally), and that it is the product of the areca palm.

The native druggists also confuse mochras with the gum of of sohájna (*Moringa pterygosperma*) which is a red astringent gum, but this mistake leads to no difficulty.

It is also curious that when I showed my *Bombax* mochras to druggists of Lahore, they said that was not real "mochras," though beyond all question it was absolutely identical with specimens in the exhibition sent as mochras, and also with some sent as "phūl-supyárí." *Their* idea of "mochras" was a red gum like that of *Moringa*.

Yours truly,
B. H. BADEN-POWELL, C.S.

Compounding Forest Offences.

(*Sec.* 67, *Indian Forest Act.*)

MY DEAR BADEN-POWELL,—I should be very much obliged if you would kindly give an opinion on the following point:—

I believe that, ordinarily speaking, a felony cannot be compounded; and that any person who receives a gratification with a view to compounding a felony can be punished. But section 67 of the Act admits of forest officers compounding some kinds of offences, which, if they are not felony, are something very like it. I understand that the object of this section of the Act was to enable forest officers to show people that they cannot now do certain acts which they and their forefathers may have been in the habit of doing for generations, and thus to punish ignorant persons who may commit small offences without the trouble of bringing such offences under the Penal Code, and without making such a serious crime of the offence as dealing with it under the P. C. would involve.

* In native medicine it is styptic, and useful in diarrhœa, dysentery, menorrhagia, &c., &c.

But the question arises as to how far this section should be used when dealing with serious crimes, such, for example, as those committed by educated merchants, who come into our forests and make a small purchase, and then use their position to commit a serious fraud by cutting down many green trees and stealing them; so that, if compensation were taken at all, it must be fixed at hundreds or even thousands of rupees. I am inclined to think that section 67 was not intended to meet such cases, and I feel as if we should be doing something morally wrong by compounding an offence of this sort.

At the same time it should be remembered that to take compensation is often our surest way of recouping ourselves for the damage (for it is so difficult to prove forest cases in court); and that in many instances the offender would feel the payment of the money very much.

Yours truly,
FRED. BAILEY.

DEHRA DUN, *8th September* 1882.

MY DEAR BAILEY,—As regards the general question of offences being compounded, the distinction of "felony" is not known to Indian law: it is quite historically and peculiarly English law. Offences that are committed in connection with forests, or their produce in transit, come under one of these classes:—

(*a*). They are solely under the Forest Act.

(*b*). They *might* be under the Forest Act, but being of a grave nature, they are in fact prosecuted under the Penal Code.

(*c*). They are not under the Forest Act, but solely under Penal Code, though connected with wood, &c., &c., *e.g.* an act of receiving stolen property; breach of trust by a contractor making away with timber to save himself the trouble of launching, sawing, or sliding to river, &c.; *abetment* of an act of *theft*.

As regards offences (*a*): All can be compounded in virtue of the express provision of section 67.

As regards (*b*) virtually the same: because as you have not yet prosecuted, you can still choose whether you will go under the Act or the Code, and, therefore, you can elect to regard the case as one to be dealt with under the Act, and then compound under section 67.

As regards (*c*), section 67 does not apply, because a *forest offence* (as the term is used in the Act) means an offence punishable under the Act or Rules; but although many "forest

offences" may be also *prosecuted* under the Penal Code (section 66), that forest does not extend the meaning of "forest offence."

Such offences (purely Penal Code offences) can only be compounded under section 214 of the Indian Penal Code, last clause "Exception." No one has ever succeeded in understanding what that clause means, but in the course of judicial decision it has come to be understood that offences under certain sections only *can* be compounded. All this will be quite clear from 1st January next, when the objectionable clause is *repeal'd*, and is provided for by the plain section 345 of the New Criminal Procedure Code (Act X of 1882), which distinctly gives *a list of sections* that *can* be compounded. And as this is exactly what has been held all along, you will be quite safe, *even now*, in believing that any offence mentioned there *can* be compounded, and any one not there can not.

There are of course provisions for not going on with a case, dropping the prosecution, &c., as when in a summons case, the prosecutor chooses not to attend, the accused will be acquitted. So in a case taken in hand by a *public* prosecutor, he can withdraw the charge. This is as regards the prisoner and letting him off, is in some sort of analogy to the act of compounding, though, to act in this way *for* a *consideration* would be not only morally disgraceful, but also a criminal act, unless the offence was legally compoundable.

As regards the practical use of section 67, that of course is a matter for the good sense and discretion of the forest officers. It can only be applied to acts which are offences under the *Forest Act* (even though they might come under the Penal Code) *e.g.*, a very grave theft of Government trees might be a "forest offence," and, therefore, might be compounded, but inasmuch as it might also be punished as a non-compoundable offence, 379 I. P. C., it would, if a grave case, be a gross want of discretion, though not strictly *illegal*, to compound it.

It was impossible to avoid this possible inconsistency; but practically the difficulty is solved in saying:—"If an act is an offence defined in the Act, and *also* one which will come under the Penal Code, consider the character of the offender, and the nature of the offence. If it is slight, and no great villainy appears, then it is a Forest Act offence, and compound under section 67 if you please; but if it is grave, treat it as a Penal Code offence, and then do not compound."

In respect to the temptation to forest officers to act under section 67 *because* they think that a prosecution will be difficult, and that they are *more likely to get redress* this way, that is hardly a desirable feeling. The object of the section is to facilitate summary remedies for *real* offences, not for ones that can *doubtfully* be established. It is no doubt also to secure punishment of offences in which there is a *clear case, but* it might be difficult to get the witnesses at a distant court:

also where the offender or his cattle would have to be taken to a great distance to a regular court.

No section of this kind can be so worded as to dispense with thoughtful, reasonable, and righteous action on the part of those who are to administer it: people who therefore are entrusted with discretionary powers are morally bound to be more than usually discreet in their exercise.

Yours truly,

B. H. BADEN-POWELL.

LAHORE, 12*th September* 1882.

Rafting Bamboos.

The Traffic Manager, Ganges Canal, Meerut, has requested us to explain the reason why natives prefer raft-borne bamboos to those transported on boats, although the carriage by boat is far cheaper than by raft, rafts being discouraged on the canal as they injure the banks and block up the bridges. He says that the bamboos in rafts are generally twenty days in the water before entering the canal, and afterwards it takes them six days to be floated 100 miles, and the question arises whether the immersion benefits the bamboos so much as to *counteract* the loss by carriage, which is nearly nine annas per 1,000 bamboos for 100 miles.

There is no doubt of the great advantages of rafting bamboos.

In Bengal it is considered advisable to keep them soaked for three weeks or a month after they have been cut before using them. Bamboos not thus soaked are attacked by insects which perforate their rind in a number of little holes from which a powdery dust continually falls. The insects are doubtless attracted by the reserve material of starch, glucose, &c., contained in the bamboos, and which being for the most part soluble, after it has fermented a little owing to the heat and moisture to which the bamboos have been exposed, is thus washed out of them during the soaking they get whilst being rafted.

Effects of forest fires on reproduction in Teak Forests.

WE have received a note from "J. N." on the cause of hollowness in mature teak trees, which we regret to be unable to print in its entirety. After noting the great number of teak trees in Burmah which, to all appearances sound, are found to be hollow owing to the former prevalence of jungle fires, he suggests that fires by attacking the close tough felty covering round the seed prepare it for germination; and he proposes that failures in sowing, which have been repeated twice in

five years in the Tharawaddy and Prome districts, might be avoided by mixing the seed with dry grass just before the rains, and burning it rapidly in imitation of the former usual conditions, and thus a year's delay might be saved. We may add that a system, similar to the one here proposed, used to be, if it is not still, followed in the Bombay Presidency. The seed was sown thickly in a bed in the hot weather, and covered over with grass and straw, which was watered copiously up to just before the burst of the south-west monsoon. After the watering was stopped, the half decomposed covering was fired, and it was found that the first heavy shower of rain brought up a good crop of seedlings.

"J. N." also raises a question which we put in his own words :—

"Will teak, unless special measures be taken for the subordination of other kinds of trees, continue to assert itself within fire traced reserves; or is it likely to be overpowered by genera of trees better able to stand shade in their youth, and whose seed germinates more rapidly than teak-seed? The fact of teak being a light-loving tree is indisputable. It nowhere forms pure natural forests except on low knolls adjacent to paddy fields—sites over which the jungle fires annually pass with unfailing regularity. But in fire protected reserves these circumstances, on the whole so favourable to teak, are precisely those to which the whole system of fire protection is diametrically opposed."

We could reply to this question at once, but the answer would be a long one, and must be postponed until another opportunity.

Cuttings from Eucalyptus globulus.

Sir,—I have never heard of any one making cuttings of *E. globulus*, although the practice is perhaps extremely common. So I write to tell you of my success in growing, transplanting, and putting out cuttings in the Himalayas at an altitude of 6,700 feet.

I obtained a large packet containing some 16 species of *Eucalyptus* from a Vienna firm in March 1881. I sowed all the seeds in my garden in rows about 1½ feet apart during May. The position was most unfortunately chosen, as my garden is on a ridge, and every day I am treated to a strong wind from the south-west which commences at noon and lasts till sunset. By July the seeds only of *globulus*, *resinifera*, and another species had germinated; all the rest had failed utterly. In October I transplanted all the weaker and smaller *E. globulus* plants, now about ten inches high. In December I covered them all over with grass to protect them from the snow. On my return from the plains in April I found the transplants had outgrown

the plants left in the nursery, and were now two feet six inches high. With the return of warm weather all the plants made astonishing progress, so much so that the branches were getting too heavy for the parent stock. I cut off all the lower ones, and my gardener stuck them into the ground in rows. To my delight, after the lapse of a fortnight, I noticed that the cuttings were putting out tiny leaves. This decided me to try the effect of transplanting the trees remaining in the nursery, now grown some six feet, and also the last year's transplants, which were even higher. I took them all out during a heavy rain, and planted them on the north-east side of the ridge so as to protect them from the wind. For a few days they all looked very sickly, but now they are growing rapidly. The conclusion I have come to is that the *globulus* is like the Pansy —"the more you transplant him the better he is." Now for the *resinifera*. This is a grovelling sort of plant; at least I can't induce mine to grow up. It prefers lying prone, although, when stretched out, the biggest plant is over five feet high. Strange to say the stem is thicker than any of the *globulus*. Has the Forest Department succeeded with larch? Last year I had a bagful of seed fresh from England given me. I sowed the seed in every likely and unlikely way, in all manner of soils, and in all months, commencing from April and ending in October, but I have had no success whatever. What is the Scotch method of sowing the seed? The hazel I got from England is succeeding admirably (there is any amount growing wild in the Kernaithi forest between Narkanda and Kotghur, but the nut is worthless). My gorse too has had the effect of putting the langúrs to flight when they attempted the passage to my garden. I want now some Spanish chestnut; it ought to succeed well.

MUNDI STATE. RIVERINE.

[The larch seed was probably bad, or was sown too deep. If the soil be sufficiently friable, and the seed be good, and only just covered with soil, there should be no difficulty about its germination, but *vide* Brandis' Forest Flora, p. 532, where it is stated that all attempts to grow larch in N. W. Himalaya have failed.—ED].

The Man-eating Tiger of Garhwal.

In the spring of 1881 the celebrated man-eating tiger of Kalagarh and Saneh in Garhwal was feared far and wide, and when I was encamped at Kohtri, in the Kohtri Dún, a party of Goorkhas from Almorah came down to Kalagarh on the Ramganga river to shoot this tiger. He had, apparently, made Kalagarh his head-quarters, and his "beat," it was said, included all the hilly country within a radius of 50 miles northward of Kalagarh. Several attempts had previously been made to kill him, but all without success. The Goorkhas established themselves at Kalagarh fully determined to rid the country of this terrible pest, but unfortunately they did not, I was told, go the right way to work. Instead of endeavouring, systematically, to track or mark down the tiger in a manner calculated to alarm him as little as possible, they went in for indiscriminate slaughter, shooting at everything within reach. The consequence was that Stripes took alarm at the unusual noise going on, and, thinking discretion the better part of valour, quietly, and without giving any notice of his intentions, left that part of the country. He travelled along the watershed, which, beginning near Kalagarh, runs almost due north-west, and terminates near Kohtri, and came to a halt at its foot, about half a mile from my camp. There were at that time a large number of bamboo-cutters in the Dún, and these men were in the habit of wandering fearlessly about the hills, a man-eating tiger never having been heard of in that part of the country.

One morning five of these men went up the hill side, as usual, to cut bamboos and grass; one of the five, thinking he would find these products more plentiful a little further up, left the others, and continued his walk up the hill, having previously asked the others to give him a call when going home. In the afternoon, however, when they called for him he was not to be found. A search was made till nightfall, and continued again next day, but without success. In the afternoon of the second day these men came to my camp, and reported to me what had happened. I immediately came to the conclusion that the missing man had either fallen down a precipice, or had been mauled by a bear! I got together my own establishment, and as many bamboo-cutters as I could find, and sent them all up the hill side to search the place carefully, while I, on an elephant, beat up all the high grass in the vicinity. This was kept up till dusk, but no sign of the missing man could be found.

Next morning, the third day, I was marching down the road to Saneh. When I had got about two miles down the road I met a boy with some buffaloes hurrying up the road. He told me that in a sot, or deep gully, not half a mile from

where we were, there was a tiger who had charged them, and driven them away when they went there that morning to collect their bamboos, and that the tiger appeared to be eating something. He told me an elephant might easily be taken up the sot, and he offered to guide me to the spot. When I had proceeded some distance I came to a piece of ground which I thought was a little too steep for an elephant; moreover, judging by the look of the ground ahead, I thought that I should gain no advantage, even if I did take the elephant further up. I, therefore, dismounted, and taking a rifle and the *mahout* with me I followed the guide up the hill side. I told the latter to warn me when we approached the spot. I had not the least intention of attempting to shoot the tiger on foot! I went up only to reconnoitre, and to find out if it were possible by making a "*detour*" to take the elephant up there if I thought it worth while doing so; or if there was any likelihood of my being able to bag him by sitting up on a tree over the kill. We walked on for some time up a spur with a deep precipice on the right, and a small stream in gently sloping ground on the left. The ground on the left was covered with dense scrub jungle and bamboos, and a few scattered trees of dhaora, bhalao and sal. I was busy noting this when the guide suddenly stopped, and, pointing to a spot not more than four or five yards off, said: "This is where we were standing, and that is where the tiger was lying." The *mahout* then picked up a piece of bamboo, and throwing it into the little *ravine* to our left said: "Is *that* where the tiger was?" Before the guide had time to reply we heard a low growl. I immediately seized my rifle, and began to look about for a safe spot to retreat to! In the meantime a continuous growling was kept up, but I could not possibly tell where it came from. At one moment it appeared to come from the ravine at my feet; the next moment it sounded as if several yards away. The guide said it came from above, the *mahout* said it was below, and I thought it was in the ravine at our feet. This went on for some time, probably a minute (to me it appeared very much longer!) I then asked the *mahout* if he could bring the elephant up, and on his saying he could do so, I climbed up a tree, and sent the two men down. I noticed that while I was climbing the tree the growling ceased. The tiger, I thought, has either gone, or is preparing to attack us! I scrambled for a seat, took the rifle as quickly as possible, and sent the men the shortest cut down the hill, and in the direction opposite to that in which the tiger was. While the men were away I carefully watched every inch I could see of the ground in the hope that I might get a shot at the beast. When the elephant came up I got into the howdah from the branch on which I was seated, and went straight into the jungle. When there I found that there was a second ravine

about 10 or 12 yards beyond the one near which I had been standing. The elephant gave unmistakable signs of the presence of the tiger, and I expected every moment to put him up: but he had gone. I beat up all the grass, and then turned to go down again, when the man I had behind me in the howdah drew my attention to something black, which was just visible in the grass. I took the elephant up to this object, but I couldn't tell, even with the aid of a pair of binoculars, what it was. After a great deal of coaxing I succeeded in persuading the man behind me to get down. He cautiously approached this black object, and then in a tone of great relief said: "Oh! this is the head of a man!" I only then became aware that I had been in the presence of *the* man-eater, and fully realized the extent of the danger I had been in; for this tiger had, on more than one occasion, dashed into the midst of a gang of men, and killed two or three of them. The thought of what *might* have happened sent a cold shudder through me, and I felt truly thankful that I had got off safely. Had he charged us I could hardly have done him much harm under the circumstances.

I carried the head down with me, and it was identified by the bamboo-cutters as that of the unfortunate man who had disappeared three days previously. I then sent it on to the thanadar at Kohdwara.

The Goorkhas at Kalagarh shot a tiger, but it was not the man-eater, as was proved by the number of men killed subsequently at Saneh.

They nevertheless received the reward (I believe Rs. 500) that had been sanctioned for the destruction of the tiger, as it was very difficult to prove at the time that the tiger shot by them was not the right one, especially as the Goorkhas asserted that they had found some human remains in the animal's stomach. Sir Henry Ramsay therefore determined to give the men the benefit of the doubt.

There is, however, one fact which may perhaps go towards establishing the identity of the Saneh and Kalagarh tigers. It is that the Kalagarh tiger from the shape of his pug was known to be club-footed, and when the tiger shot by the Goorkhas of Dehra was examined, it was found to be defective in the first two toes of one of the fore-paws, these two toes having withered away from the effects of a wound it had received.

The terror inspired by the presence of this tiger was so great that the forest was at length deserted. He was always on the watch. Seated on a commanding spot he used to wait for the first sound of an axe, and then skilfully stalk and pounce upon the unfortunate individual using it. This became so bad that the bamboo-cutters deserted that part of the country, the forest produce remained untouched, and the revenue fell in consequence.

The Inspector-General of Forests, therefore, deputed Mr. Dansey to shoot this tiger, but unfortunately he was recalled before he had quite completed his arrangements.

The honor of shooting the "man-eating tiger of Garhwal" fell to the lot of a small band of plucky little Goorkhas from the regiment at Dehra. These men tracked the tiger into a narrow sot near Saneh, and "tossed up" to decide as to which of them should lead. They came upon him suddenly, fired a volley, and dropped him. Thus fell this formidable beast who for years had been the terror of all the unfortunate bamboo-cutters in the Patli Dún, and its vicinity. All the attempts made by the officers of the Forest Department, and by shikaris to shoot him or to poison him, had failed; and the little Goorkhas carried off the reward that had been offered for his destruction.

I believe that in this case too the reward was Rs. 500. There is a general belief that the skin of a man-eating tiger is mangy. The skin of this particular tiger is now I believe in the possession of Mr. Parker, District Superintendent of Police, Saharunpore, and I am assured by a gentleman, who has seen it, that it is a very fine skin with a thick glossy coat.

It is supposed that a tiger turns "man-eater" only when, owing either to a wound received or to old age, he becomes incapacitated from running down his natural prey. This may be true in some cases, but is not I believe a generally established fact, as instances have been known in which neither of these conditions existed.

L. E.

Bee-keeping in India.

In continuation of the correspondence which appeared in our issue of the 20th June last, we now publish the following extract* from a letter from an officer of the Forest Department, Madras, on the subject of apiculture in that Presidency.

Letter from the Deputy Conservator of Forests, Madras, No, 301, *dated* 31*st January* 1882.

* * * * * *

There are four species of honey-producing bees in the Wynaad. The largest (*Apis*, Sp?) builds, as a rule, on the inaccessible ledges of precipices, preferring such as overhang rivers; also on the largest trees in the forest, preferring those that are isolated, and have numerous horizontal limbs. Such trees, as *Bombax malabarica, Mangifera indica, Ficus,* &c., are usually preferred, and the colonies return to them year after year without fail. Such trees and precipices are known as "Burrays," and used to be the property of Kurumber "Hadis" (villagers), each Hadi possessing a certain number of Burrays.

* "The Asian."

Such Burrays are now the property of Government, except where they are situated in private lands. There are two crops in the year, in May and November, and the honey and wax are gathered when the nights are dark, *i. e.*, just before *ammavassi* or new moon. The combs are usually built, when on the ledges of precipices, facing the north-east, to avoid the blow of the south-west monsoon. The comb is semi-globular near its attachment to the rock, and 2½ feet to its junction with the lower half, in which is contained the larvæ. The pollen, which is the principal food of the latter, and is generally known as bee-bread, is deposited in the cells at the junction of the upper and lower portions. The queen and drone cells are generally to be found near the edge of the comb. A fortnight after the larvæ attain their full development, and appear as imagos, the colony splits into two—the parent and infant colonies separate, and seek other trees and fresh pastures. The number of colonies that seek a Burray in a season depend entirely on the season, and the amount of flowering trees in the neighbourhood. The bees, when they desert the tree and comb of the season, do not make their way to the nearest Burray, but frequently travel for a week or ten days to distances of over a hundred miles, even crossing such mountain chains as the Nilgiris in their migrations.

The best honey-producing flower of Southern India is the *Strobilanthes*, which not only forms the principal undergrowth of the Sholas, both temperate and tropical, but spread over the grassy slopes of the higher elevations.

There are an immense number of species in this genus, and they almost all flower once in seven years, dying down entirely, and afterwards a fresh growth springing up from seed. Whenever any species of *Strobilanthes* flowers, colonies of bees migrate from all parts of the country to feast on the honey, and rear their young broods. At such times honey becomes plentiful and cheap, and as the *Strobilanthes* honey is of the finest quality and flavor, even rivalling that from the famous Mount Hymettus, it is eagerly sought after by the Todas of the Nilgiri hills, and in fact all the aboriginal tribes. The year 1879 was such a season for honey that it sold at the rate of 4 annas per imperial pint, whereas its usual price is from 8 to 10 annas. This honey in the cold climate of the Nilgiris crystallises in from a fortnight to three weeks, when the flavor becomes richer and finer. In the Wynaad, as soon as the moon has waned sufficiently, great preparations are made to take the honey. Bamboo and rattan ladders are constructed. These are sometimes of astonishing length, and at nightfall, after 9 P. M. (for the bees do not go to bed till then, as you will find to your cost if you disturb them) the *Jain* (honey) Kurumbers proceed to the Burray, and having erected their ladders if they have to climb upwards, or suspended their cane

ladders if downwards, arm themselves with torches and knives, and sever the combs from the rock or branch. The drowsy bees, meanwhile roused by the glare of the torches, desert the combs and buzz aimlessly about, alighting in thousands on the rocks and branches about and even on the persons of those engaged in taking the combs, but never attempt to sting, unless crushed or hurt. The combs are then lowered down in baskets, the Kurumbers feasting on the larvæ, which taste something like cream, whilst the fish which swarm in thousands when the hives are built over a river, have a glorious feed on the grubs and bees that fall into the water and float helplessly down stream. The upper portions of the combs containing the honey is detached and thrown into a coarse canvas bag, which is squeezed with a tourniquet, the honey flowing into a copper cauldron, in which it is afterwards boiled to prevent fermentation. The wax is boiled separately in water and then strained; it is afterwards melted and moulded into sheets, which, being exposed to the sun to bleach, are remelted into blocks of a cwt. each. To attempt to interfere with these bees during the day is madness, and many a sportsman and traveller has barely escaped with his life after doing so. Indeed it is no light punishment to be assaulted by the countless hosts of infuriated bees that attack you on the slightest provocation, and it is only necessary to light a cheroot, and sometimes even merely to go near them, to draw down their vengeance on your head. Nothing can then be done but to hasten to the nearest pool of water, and leave nothing visible but your nose above it. I could give numerous instances of men, cattle, horses, and even fowls and pigeons, being killed by those bees; but I have no space for such in this letter. These bees, however, will not attempt to sting you unless they have stores of honey and their young to guard, for it must be remembered that the insect sacrifices its life when it stings you in the defence of its hive and young; the sting being so constructed that the poison-bag is torn out of the body when the bee tries to withdraw the sting from the skin in which it is firmly fixed.

The next species of bee which I am now going to describe is about half an inch in length, and of a dark-brown color, the abdomen ringed with pale yellow. The thorax is generally infested with a minute parasitical insect. It forms its combs in the hollows of trees and rocks, and sometimes in hollow caves of the termite nests, which are so abundant in the Wynaad. Unlike the first-mentioned species, its combs are of nearly the same thickness throughout, *i.e.*, nearly three-quarter of an inch between each row.

The honey is superior to that manufactured by the cliff bee, and thicker, but is occasionally poisonous, when the honey is collected from such plants as the various species of Lobelia. It is then acrid to the taste, and, if swallowed produces nausea and violent purging.

This bee I believe to be identical with European species, and more like the Ligurean variety. In Coorg it is domesticated, and the hives, made of the hollowed-out trunks of trees, are placed near houses; but the Coorgs have no notion of collecting the surplus honey by such contrivances as bell-glasses, &c., as they do in apiaries at home.

On the Nilgiris I have tried numerous experiments, and succeeded admirably. There is no reason why apiculture should not be successfully carried on at Ootacamund, and other highlands in Southern India. I found that an ordinary beer cask, placed in a warm and sheltered situation, made the best hive; a small board nailed on near the bung-hole serves for the bees to alight on when leaving and entering their hives. When the swarm has been thoroughly established, *i.e.*, when two or three other swarms have increased the strength of the parent stock, bell-glasses can be placed on the top of the cask over holes bored for the purpose, and removed from time to time, as they are filled by the industrious little workers below. When bees have ample space to work in, queens are rarely or never bred; it is only when the accommodation proves insufficent in the hole in which a wild swarm takes up its abode, that the young swarm has to look out for a fresh home, accompanied, of course, by its young queen. The Todas on the hills, when they take a hive, invariably block up the hole with two or three stones. This is done because these bees object to too much light. Residents on the hills are frequently annoyed by swarms settling in the tiled roofs of their houses, and stinging children and servants. This could easily be prevented by providing proper hives for them. Half a dozen empty casks would be immediately tenanted, and the honey could be turned to account.

In April and May, when the iron-wood (*Mesua ferrea*) blossoms, this honey is abundant, and of the most delicious aroma and flavor. Bees are very peculiar in their likes and dislikes, and, while they will allow one person to plunder their hoards without hurt, will violently sting others. It is difficult to explain this peculiar power which the bee-masters and bee-kings at home exhibit, but one of their great secrets undoubtedly is to treat the bees gently.

I myself personally never scruple to help myself to any honey I may discover in the forests, and rarely or never got stung, and even when stung, the poison has no effect on me; whereas I have seen others, perhaps persons of more delicate organization, who have suffered severely from a single sting.

The third bee on my list is a little fellow not much larger than a house-fly, and supposed to be stingless; but such is not really the case, for it can, and does, sting when it is angry. It builds generally on low bushes, and makes a small comb about a foot in length, with about a pound of honey near the top.

The honey is easily secured; all that is necessary is to cut off the branch on which the hive is, with your shikar knife, and give it a shake, and the honey is yours. The honey is thin but well flavoured, and is usually brought round for sale at Ootacamund by the Badagars, in whose country it is common. This bee is easily or never found over 5,000 feet elevation, preferring a warmer climate. It cannot be domesticated.

The fourth is a very minute bee known by the natives as the mosquito-bee. It builds in the holes of trees and walls. There is no comb, the honey and pollen being deposited in small globular cells of a dirty-brown waxy substance, and in no particular order. The larvæ are contained in a mass of minute agglutinated cells. The honey is poor and acrid, and only eaten by the poorer classes. The wax resembles cobbler's wax, and is pasty in consistence.—*Asian.*

A trip through Chamba.

(*Continued from p.* 35.)

19*th June.*—Early in the morning we started with the intention of trying to reach the Pukrung Galla, the great gorge in the Rundhar range, as by so doing we should see a good deal of the forest. It was a stiff climb; the "ups" were very steep, and the "downs" nearly sheer in many places. One needs a good head, wind, and stout legs for these hills. The paths are merely goat tracks. For the most part "chaplis" are good enough for this sort of work, especially going up, but in coming down great care has to be taken, as one's foot has a way of getting up after the manner of a beginner on the rink. I have put a few screws in my chaplis, but although it preserves the sole, still it is liable to make one slip more on rock. In the Sukret nullah, about 6,000 feet or over, I found *Aspidium Thomsoni* for the first time, and as I did not know it I thought it something new! From the bed of this nullah it was a steady steep climb over projecting roots, rocks, &c., up a steep ravine to the top of the Rundhar range, but the delightful air and view, when there, fully compensated us for the severe pumping. The range on the south side is a sheer cliff in parts, but covered with grass, and is very conspicuous from Dalhousie. Just below where we were standing we found the first "Devidiar" (*Cupressus torulosa,*) but almost out of reach, as it grows out of the face of the cliff. This is not the Pencil Cedar, which in Chamba is called "Luir." We were told we had reached the Pukrung Galla, but doubted it, and subsequently found we were not near it. Continuing along the range we ascended to the top of the highest peak (about 9,800 feet) and came among *Q. semecarpifolia* and *Lastrea indus.* We now descended through the forest for home, a tiring trudge,

partly through thick undergrowth and then down a steep ravine. At the bottom was a beautiful stream of clear water, and here we rested and had a tremendous drink. One more short climb over a small ridge brought us home. At this camping place (Chanán) we find the sandflies very troublesome, although we are up at nearly 7,000 feet; in fact we had to resort to musquito curtains at last. It is also warm at night, and we leave the tent open, using only one blanket.

20*th June*.—Made a short march to Kansor a "Got" ("báthán" in Darjeeling) on the top of the Lindi-bé range. On the road measured a fine walnut, 12 feet 6 inch girth, but of no great height. Found a great deal of *Pellea nitidula*, new fronds just appearing. This is in perfection in September and October. Also some *Cheilanthes subvillosa* and *dalhousiæ*. During the day we went along the Lindi-bé range, through the forest of that name, to the highest point, returning lower down. This is the wreck of a Deodar forest consisting principally of old trees, very few seedlings or young growth. From the top of the peak we could see the Pukrung Galla, and as we expected were not within a mile of it yesterday. It was quite cold at our camp, which was near the top of the ridge, and for the first time we made a regular camp fire at night.

21*st June*.—To Súndri Garat or the water mills of Sundar just below the Chanju "Koti." Our way lay past the village of Jálá, and was on the whole a rather severe walk. The first mile or two a steep descent down a ravine; then up the Chanju valley. On the way we crossed the Paséd nullah, an exceedingly pretty stream. Here we stopped, and taking off our boots had a wade in the stream, which refreshed us greatly as our walk had been nearly all in a blazing heat, over a bare hill side and along a mere goat track. These villagers are really wonderful people to carry a load over a place that we had to look carefully at before we attempted it. From the Paséd nullah the road is not far off the perpendicular to where it joins the Chamba road, along that for a short way, and then straight down the hill side to the "Garát" or mills on the bank of the Chanju stream, the first really large torrent we have seen. In the village lands near we saw many fine walnut of very fair girth, 12 feet to 14 feet, but no length of stem. Of ferns the most noticeable were the *Woodwardia*, in immense quantities, some fronds 6 feet long; *Pellea nitidula* common on bare rocky places; *Aspidium falcatum* here and there; and though last not least *Gymnogramme totta*, which I found in the Paséd nullah only. Directly we arrived at our camp we went down to the Chanju stream, and had a bath, very refreshing indeed, but as the water was ice cold, we could only take a dip or two and then out. Round about our camp we found many trees which looked like Elm; the villagers call it *mandú*; if so, it would appear to be the *Ulmus* No 2, at page 341 of the

"Manual of Indian Timbers." It is quite distinct from "Marál" (*Ulmus wallichiana*). "Mandú" grows to a very large size; we saw several nine feet girth and over, and perhaps 60 feet to 80 feet high. Here we first saw the beginning of timber work, for in the Topi forest close by a number of trees were felled last year, and the logs are now being worked out. They are marked with the double triangle (the Punjab "Government mark"), and numbered in the forest, then measured and entered in a register, afterwards being rolled down into the bed of the nearest stream—in this case a mere torrent, called the Mahéd nullah, available for floating only in a flood when the logs are washed down into the large Chanju stream and gradually find their way into the Suil river, and so down into the Ravi. Gangs of men are always working in the first stream, rolling any logs left high and dry; again down into the water way, and very hard work it is, they have to stand in the cold water for hours, levering logs over rocks, &c., into the water; and clearing a jam is still harder work. They use wooden levers, about 7 feet long made of "Killar" principally, and sometimes hardened in the fire. These men are employed by our contractor and work under a mate—the coolies receiving Rs. 5, and the mate Rs. 6 per mensem, while the contractor receives 1 anna per cubic foot on arrival at a place just above the junction of the Suil and Ravi rivers. If there are no heavy floods he is liable to a heavy loss, as of course if no logs come down he receives no payment from us, though he still has to keep up his gangs of men in the hopes of floods.

Just now the watermills are in full swing, grinding wheat and Indian corn. We sent for some of the latter, and tried it in *chupatties* and liked it very well, though I dare say it is not so wholesome as refined flour.

22*nd June*.—To-day office work kept me in half the day. I only get my dâk every third day; and as the man has to go back at once there is a spell of hard writing directly he comes. In the afternoon we went up the Mahéd nullah and made experiments in the bringing out of logs to see if it was possible to get them down the small nullah, but it would not do; the log was started into the stream, floated about 20 feet, and then jammed against a rock. Started again, only went ten feet this time, and stopped again, so we were quite of opinion that there is nothing to do but wait for the floods to take them into the large stream. We had even grave doubts as to whether even a conservator's official order would have got them down! It rained pretty hard in the afternoon, and then the sun came out again. We find the small black flies, called "pipsi" in Darjeeling and "potu" in N. W. P., very annoying here, especially towards evening and early in the morning, when they flit about in myriads biting one on every empty space.

23*rd June*.—To-day explored up the Mahéd nullah as far as a waterfall, a pleasant ramble; stopped now and then to gather specimens, and to check measurements of logs. Saw some fine trees of the "mandú" Elm, over nine feet girth, had two marked for felling for the Lahore market. It is possible now-a-days, when Lahore has so largely increased, that some of the despised woods may find favor. With a good deal of climbing, and some rather difficult places to clear, we reached the foot of the waterfall, and stopped there some time enjoying the scene.

The waterfall is rather a fine one, perhaps 40 feet or more in height, and the water falls quite clear into a pool at the foot. Into this pool logs are shot from above and come to no harm in the process owing to the depth of the water. On our return we rushed down to the Chaiyu stream, and had a bath in the water just melted ice. Quite took one's breath away after a dip, but then the glow which succeeds it! There is only one word to express one's state after a bath of that kind, and that is *fit*. I bathe wherever I find clean water, but observe certain conditions—one is to be heated from exercise, walking for choice; the next to bathe in sunshine and not cloud; then never to stop in long and to cover one's head when not under water. Under these conditions I have bathed from boyhood in Australia where I used to stop at every creek up to the present time, and cannot recall the slightest inconvenience from so doing, when I cease to be able to do it I shall know I had better retire!

J. C. McDONELL.

(*To be continued*).

Translation of Bagneris' Manual de Sylviculture.

SIR,—A revised edition of the translation of Bagneris' *Manual de Sylviculture*, prepared by Mr. Smythies and myself, has just been published in England. The price in England has been fixed at 5*s*. per copy, which, with postage, &c., will come to about Rs. 3-8 in India. No arrangements have yet been made for the sale of the book in this country, but those who require copies will obtain them through any bookseller or agent, or by communicating with me.

Yours truly,

E. E. FERNANDEZ.

DEHRA DUN, 20*th September* 1882.

Method of Destroying Wasps.

SIR,—Have any of your readers heard of, or tried, the following method of getting rid of wasps' nests in the verandah? It was told me by an old police inspector; but as I am now living in a country where wasps are not, I have never tried it. Get a china basin, clear it thoroughly, place some sugar, treacle or any sweet stuff in it, then lead a stick to serve as a ramp from the basin to a black ants' nest (the big square-headed fellows are the best.) Then, when the basin is pretty full, place it directly under a wasp's nest, lead a long stick from the basin to the nest, get behind a *chik* promptly, and watch results. The ants, unable to crawl up the slippery side of the basin, will swarm up the stick straight into the wasps' nest. Then commences an awful fight. It ends by the ants nipping the wasps in two and strewing the verandah with dead bodies. Such is the tale as told me. Never having tried the method I can't say whether it would turn out a success or failure. By the way, have you noticed that in almost every black ants' nest there is sure to be a scorpion, goes there, I suppose, to fatten on the larder of its unwilling hosts. Pour some hot water into the hole and you will soon fetch scorps out with 20 or 30 ants sticking to him most affectionately.

RIVERINE.

[With reference to "Riverine's" method for destroying wasps we give an extract from the *Gardener's Chronicle*, from which it will be seen that the carnivorous propensities of ants are utilized in China most advantageously.—Ed.]

THE UTILISATION OF ANTS IN HORTICULTURE.—Professor Riley contributes the following note to a recent number of *Nature:* Dr. C. J. Macgowan has sent me, from Hanchow, Province of Hainan, China, a little paper on the Utilisation of Ants as Insect Destroyers in China. It seems that in many parts of the Province of Canton the orange trees are injured by certain worms, and to rid themselves of these pests the inhabitants import ants from the neighbouring hills. The hill-people throughout the summer and winter find the nest of two species of ants, red and yellow, suspended from the branches of various trees. The Orange ant breeders are provided with pig or goat bladders baited inside with lard. The orifices of these they apply to the entrance of the bag-like nests when the ants enter the bladders, and, as Dr. Macgowan expresses it, become a marketable commodity at the orangeries. The trees are colonised by placing the ants on their upper branches, and bamboo rods are stretched between the different trees, so as to give the ants easy access to the whole orchard. This remedy has been in constant use at least since 1640, and probably dates from a much earlier period. This is certainly a new way of utilising ants, which, as a rule, are deservedly considered a nuisance by the horticulturist. Professor Riley would like to learn from any reader whether the facts communicated have before been known in Europe, and, if so, whether the species of ant has been determined."—*Gardeners' Chronicle.*

JJ. Official Paper.

Ceara Rubber.

India Office:
London, 10*th August* 1882.

To

His Excellency
The Most Honorable
The Governor-General of India in Council.

Revenue.

My Lord Marquis,

I forward herewith, for the information of your Excellency's Government, a copy of a letter, and its enclosures, which I have received from the Director of the Royal Gardens, Kew, on the subject of the Ceara-rubber tree, which has been successfully introduced into Ceylon, and seems likely to become an important addition to the economic vegetable productions of the island.

I have, &c.,
(Sd.) HARTINGTON.

Royal Gardens, Kew,
30*th June* 1882.

To

Sir LOUIS MALLET, C.B.,
India Office.

Sir,

I am desired by Sir Joseph Hooker to inform you that Dr. Trimen, the Director of the Royal Botanic Garden, Peradeniya, has brought with him to this country a sample of the caoutchouc of the Ceara-rubber tree (*Manihot Glaziovii*) of Ceylon production.

This sample is the first of bulk sufficient for experimental purposes, which has been yielded by the trees at Peradeniya. These were obtained from the stock established at Kew in 1876 from the importation of Mr. Cross, acting under the instructions of the India Office.

I am now to submit for your information copies of a correspondence with Messrs. S. W. Silver & Co., as to the commercial value of the Ceylon product.

I may remark that too great importance need not be attached to the difference between samples Nos. 1 and 2, which is probably, in a great measure, the result of a mere accident. There

seems no reason to doubt that the bulk of the Ceara-rubber, produced in the East, might come up to the standard of No. 1, the value of which Messrs. S. W. Silver & Co. estimate at from 2*s.* 9*d.* to 3*s.* per lb.

I am, &c.,
(Sd.) W. T. THISELTON DYER,
Assistant Director.

ROYAL GARDENS, KEW,
17*th June* 1882.

To
S. W. SILVER, ESQ.,
67, *Cornhill, E.C.*

DEAR SIR,

IT will be in your recollection that the plant (*Manihot glaziovii*) which yields Ceara-rubber, has been introduced into Ceylon at the expense of the Government of India.

It is now thoroughly naturalised there, and is likely to become practically a weed.

Dr. Trimen, the Director of the Royal Botanic Garden, Peradeniya, arrived in England from Ceylon on the 15th. He brought with him the accompanying samples of rubber from the Ceara plant, the first which has been produced in the island.

Sir Joseph Hooker would esteem it a favour if you could give him an estimate of the commercial value of the article as now sent you.

There are two samples, and you will observe that that labelled (2) is more glutinous and sticky than that labelled (1). A separate estimate of the value of each, supposing them to be sufficient for the purpose, would greatly oblige.

Sir Joseph Hooker ventures to trouble you in the matter, remembering the kind assistance which, on other occasions, you have rendered this establishment. He also feels that, as an opinion of the results of the experiment will be anxiously anticipated in Ceylon, he cannot apply to a more authoritative source for an estimate which will be accepted with confidence.

I am, &c.,
(Sd.) W. T. THISELTON DYER.

SUN COURT:
67, CORNHILL, E.C.,
20*th June* 1882.

To
W. T. THISELTON DYER, ESQ., C.M.G.,
Assistant Director, Royal Gardens, Kew.

DEAR SIR,

YOUR communication of 17th instant, accompanied by specimens 1 and 2 of caoutchouc, known here as "Ceara,"

the produce of plants imported into Ceylon within the last few years, and brought to England by Dr. Trimen, the Director of the Botanic Garden, Peradeniya, duly reached me.

In reply I beg to say that the samples will be forwarded this day to the India Rubber, Guttapercha, and Telegraph Works Co., for examination, with a request that the results may be forwarded to you, including an estimate of value, in accordance with the desire of the Director-General.

Feeling sure that this will meet your appoval,

I am, &c.,
(Sd.) S. W. SILVER.

THE INDIA RUBBER, GUTTAPERCHA,
& TELEGRAPH WORKS, CO., LD.,
Silvertown, Essex,
London, E.,
29th June 1882.

To
W. T. THISELTON DYER, ESQ., C.M.G.,
Assistant Director, Royal Gardens, Kew.

SIR,

REFERRING to your letter of the 17th June to Mr. S. W. Silver, enclosing two samples of Ceara-rubber, we have now the honor to enclose you our chemist's report on some after careful consideration.

The present market value of No. 1 sample is from 2*s.* 3*d.* to 3*s.* per lb. No. 2 sample we do not consider worth more than from 1*s.* to 1*s.* 3*d.* per lb.

We remain, &c.,
The India-rubber, Guttapercha & Telegraph Works, Co., Ld.
(Sd.) J. W. BAILEY.

Report of examination of two samples of rubber from S. W. Silver, Esq., accompanying letter from W. T. Thiselton Dyer, Esq., C.M.G., Assistant Director, Royal Gardens, Kew.

Description, &c.—Sample No. 1 has a dry and compact appearance, is free from extraneous impurities, and, from its tolerably uniform condition, has been collected with care. It agrees in all respects with Ceara-rubber of good and sound quality.

Sample No. 2 is soft and sticky, and is mixed with a considerable quantity of coarse sand. It is much darker than No. 1. It is very desirable that a sample of No. 2, collected without this admixture of sand, should be examined.

Whether this sand is accidentally or intentionally mixed, its presence would be a serious drawback to its use. For the better class of rubber manufactures it would be totally unsuited.

In manufacture, &c.—Sample No. 1, when washed and dried, gives a loss of 8 per cent.

This loss is much less than is met with in Ceara-rubber of the finest quality, and may probably be accounted for by the small bulk and facilities offered by time, mode of packing, and transit, to the escape of the natural moisture of the product.

Water removes a considerable quantity of mucilaginous and feculent matter and salts, the natural impurities of the rubber, and leaves it quite white and almost pure.

Alcohol extracts but a slight amount of resinous and oxidation products.

On incineration it yields 4·13 per cent mineral ash, which agrees, in its chemical composition, very closely with the ash obtained from Ceara-rubber, the ash from which amounts to 4 or 5 per cent.

This sample (No. 1) vulcanizes perfectly when mixed with the suitable proportion of sulphur and heated.

Sample No. 2, when washed and dried, gives a loss of 62 (sixty-two) per cent. The sand renders it extremely difficult to wash, unless warm water is used, which increases its stickiness on drying.

Water removes much less mucilaginous matter than from No. 1.

Alcohol removes, even on long digestion, only a slight quantity of soluble matter. On digestion in alcohol it does become harder or less sticky. This shows that its stickiness is not due to an oxidized state of the rubber, nor to the presence of resins, and would create an opinion that some other product has been added.

The chemical analysis of the mineral ash in such cases is of great assistance; the quantity of foreign mineral matter in sample No. 2 renders the analysis of the ash, in the present case, quite unreliable.

It yields 27·53 per cent ash before washing, and 6·42 per cent ash when washed and dried. Sample No. 1, when washed and dried, yields 2·9 per cent ash, insoluble salts contained in the juice of the plant.

When mixed with a suitable quantity of sulphur and heated, sample 2 vulcanizes, although not so satisfactorily as No. 1.

(Sd.) THOS. T. P. BRUCE WARREN,

Analytical Chemist to the India-rubber, Gutta-percha & Telegraph Co.

JJJ. Reviews.

District Arboriculture in the Punjab.

We have before us the reports on this work for the years 1879-80 and 1880-81, both drawn up by Dr. W. Schlich. They contain extracts from the reports of different Deputy Commissioners, varying from a few remarks to information of considerable interest, according as, we presume, the local officer is one who takes a special interest in the work or not. These reports are sent through the Commissioner to the Conservator of Forests, who draws up the general report for submission to Government. As is remarked by Government, the Hoshiarpur District Report seems to be the best, but we do not understand how it is that, though an attempt was begun in 1879-80 in planting protective belts along the roadways across some of the "chós" as described thus:

"Experiments were made in planting out and protecting the roadways across some of the 'chós.' The experiment consisted in marking out strips of land about 5 feet broad and about 30 to 40 feet apart, running parallel to each other across the 'chós.' These strips were planted out with khar (*Saccharum sara*), nana (*Malva parviflora*), and banna (*Vitex Negundo*), which took well, and after the first month required little or no care."

No mention of the results is made in the report for 1880-81, even though the orders of the Punjab Government specially asked for such mention.

The *first* report gives, for most districts, at the beginning, the average rainfall; and as this will be a useful point to note as a preface to our remarks, we give a table shewing the number of inches. We have supplied the missing data from other sources:—

Delhi Division.		*Inches.*	*Umballa Division.*		*Inches.*
Delhi District	...	29·8	Umballa District	...	22·4
Gurgaon „	...	30·4	Ludhiana „	...	14·
Karnal „	...	17·6	Simla „	...	71·
Hissar Division.			*Jullunder Division.*		
Hissar District	...	12·	Jullunder District	...	23·
Rohtak „	...	20·5	Hoshiarpur „	...	23·
Sirsa „	...	10·6	Kangra „	...	68·

	Inches.
Amritsar Division.	
Amritsar District ...	24·
Gurdaspur „ ...	30·1
Sialkot „ ...	27·
Lahore Division.	
Lahore District ...	19·2
Ferozepore „ ...	10·
Gujranwála „ ...	19·5
Rawalpindi Division.	
Rawalpindi District ...	34
Jhelum „ ...	29·
Gujrat „ ...	32·
Shahpur „ ...	8·3
Mooltan Division.	
Mooltan District...	3·1
Jhang „ ...	5·4
Montgomery „ ...	5·
Muzaffargarh „ ...	2·3
Derajat Division.	
Dera Ismail Khan Dist.	9·2
Dera Ghazi Khan „	4·
Bannu „	7·5
Peshawar Division.	
Peshawar District ...	9·6
Hazara „ ...	35·
Kohat „ ...	15·3

In almost all districts the chief trees used for roadside planting were sissu, nim, mango, pipal, mulberry and kikar, but a few others have occasionally been added, and especially siris, jáman, tamarisk and bakain. In Hazara, as might be expected, the trees used are chiefly of hill species. In some localities exotic trees have been tried, like the *Grevillea robusta* in Peshawur. The trees are usually raised in nurseries, and planted out when two to three years old.

In the matter of plant protectors there seems to be considerable diversity. Thus the Delhi Municipal Committee consider brick enclosures the best, while others prefer mud walls, and in some thorns are used. In the Gurgaon district, mud walls are said to cost three to five annas each; in Gujranwála four annas; in Mooltan three annas; and in Jhang four to five annas. In Gurgaon brick palisades are said to cost Rs. 1-10 each, but the Delhi Municipality say that this is the less expensive system. Iron tree protectors are sometimes used, and we are inclined to think that good iron protectors might be made to pay for road-avenue works, as they can be taken up and moved from place to place as required. The disadvantage of thorn fences is well described by the Deputy Commissioner of Karnal as follows:—

"The best method of raising trees in this district appears to be to provide large mud fences with a slope in the wall to enable them to stand several years' rains. Much unprofitable work has been done at one time or another by using thorn fences instead of mud fences. They are cheaper to construct, and look well, but instead of lasting for three or four years, as they require to do, they have difficulty in lasting so many months, because the white ants feed on them, and every other native who passes supplies himself from them with a little fuel to cook his food. In course of a little time the plant is exposed, and a passing goat or bullock snips off the top, and completely destroys the progress of months, or even of a whole year.

After these operations have been repeated several times, the plant, if it ever succeeds in raising its head above grazing animals, can only be a stunted scrubby tree and painful to look at. It can be observed in this district that any trees that have succeeded, have still the traces of a good mud fence around them. In future they will be constructed before the tree is planted.

"Most road sides, where arboriculture is at all easy, are infested with kikar and other trees of spontaneous growth. There is no objection to a kikar tree in its proper place. It is a very useful tree, and gives a little shade, but it is very objectionable where it is desirable to have trees of a better sort. Its vitality is such that no other trees can grow in its neighbourhood; but, on the other hand, it is very short-lived, and after it has reached a certain stage, every other storm carries away a fresh branch, and it becomes useless for shade and a wretched looking object. Owing to its existence about Karnal, there is not a single good avenue in Karnal or its neighbourhood. All along the Grand Trunk Road, where it abounds, the Public Works Department are quite hopelessly endeavouring to raise avenues of flowering trees, while they succeed excellently where the ground is clear. The kikar ought to have the field to itself if an avenue of it can be considered sufficient, or it should be remorselessly cleared out to prevent waste of labour."

Some important information is given in these reports regarding experiments with exotic trees. We have already noticed that *Grevillea* trees are grown along roadsides in Peshawar, and reported to be thriving. Of species of *Eucalyptus* it is worth noting that *E. rostrata* was well reported on in Hoshiarpur in 1880, and in 1881 the following remarks were recorded:—

"A species of *Eucalyptus*, the seed of which was received from Hazara, has been very successfully propagated in this district. We have trees between thirty and forty feet high, not five years old yet, with a girth of upwards of 18 inches. The species is, I believe, *tereticornis*. The Deputy Commissioner took occasion last year, when at Lahore, to introduce it to the notice of the Agri-Horticultural Society, and he obtained several pounds of the seed for distribution. Several trial plantations of this *Eucalyptus* have now been made in and near the station, and there is a fine avenue of them on one of the station roads. The *Eucalyptus tereticornis* is described by one Australian authority as 'suitable for rails and posts, as well as for fuel' (*Woolls*). And by another as 'an excellent timber, much used for plough beams, poles, and shafts for drags and carts, spokes for wheels, as well as in ship-building' (*Moore*). It seems very closely allied to *Eucalyptus rostrata*. We have also succeeded well with *rostrata*, a consignment of which was received from Dr. Brandis; but the trees of it are not yet so old. The *goniocalyx*, a supply of the seed of which was also kindly supplied by Dr.

Brandis, has not done very well. A great many of the young plants have died, but a few vigorous ones are doing well. Its opposite, sessile, kidney-shaped leaves are a very characteristic distinction of the species. *Globulus* is a failure here: one specimen has survived in the station of Hoshiarpur, and there are perhaps half a dozen at Bharwain. The *citriodora* has also proved delicate. The *tereticornis* seems undoubtedly the species for the Punjab. It is very hardy and rapid of growth, and soon gets beyond the need of watering."

E. Melanoxylon has thriven in Umballa, and as we have recorded in previous volumes, several species do well at Abbottabad. It is, however, curious to note how some people cannot get out of the habit of talking of the *Eucalyptus* as if all the 300 or so species of the genus *Eucalyptus* were trees of such disposition that they are capable of being planted indiscriminately. As well might we expect the Esquimaux to thrive in the deserts of Arabia, or the Malay to accommodate himself easily to the climate of Lapland. Some of the species come from tropical Queensland, others from the temperate Tasmania; some prefer the dry coast of West Australia, and others the moist valleys of New South Wales, so that when desiring to introduce some of the *Eucalypti* we must first endeavour to ascertain their native climate, and select those most suitable for the place in which we wish to plant.

In regard to the system of planting in force in the different districts not much information is available, though a few extracts from the Hoshiarpur report may be interesting. In that for 1880-81 the Deputy Commissioner says:—

"Efforts are made to have every road planted with trees at a distance of 30 feet apart.

"Nurseries are kept up at frequent intervals. There are nurseries at many of the encamping-grounds, and the road-side *malis* are encouraged to keep up small nurseries of their own. There ought to be a nursery at intervals of every five or six miles.

"*Numerous nurseries, which must be kept well stocked, are the foundation of a successful system of district arboriculture.* The forethought which provides a supply of seedlings to be used two or three years hence is not natural to the majority of natives, and the subject requires to be constantly brought before even the educated officials. Nurseries are very apt to run dry. The tahsildar is quite pleased when he has provided 500 saplings, without thinking whether he has a supply coming on *for next year's use.*

"It is a standing order that no trees, less than three feet in height, are to be planted. This is an order which has been inculcated with some pains, and seems at last to be getting understood. It is much easier for a *mali* to get seedlings one year old than to get them two or three years old. He is very apt to

plant out all his seedlings when they are six inches or a foot high, if he is not peremptorily checked. A tree, 18 inches high, when put out on the road side, will want watering for two years longer than one planted out when three feet high will require it. Planting out small saplings is a pure waste of money, for what one man can look after in the nursery, it will take ten men at least to look after in '*situ*' on the road side. The taller the trees are when planted out the less expensive is the tending of them on the roadside, i.e., *the taller you can plant out your trees the cheaper is your work.* Of course, there is a limit, but practice soon settles that. Ordinarily in the rains trees can be planted out four and even five feet high."

The 1879-80 report describes a new system introduced by a Mr. Faddy, District Engineer:—

"Mr. Faddy, the District Engineer, thus describes a system of transplanting saplings on to the roadside, which he introduced with the Deputy Commissioner's sanction. 'On either side of the road, two small trenches were dug, about 18 feet apart, 1 × 1 foot. Into these trenches, as close as could be placed, young tun, tali, mango, *Eucalyptus* and pipal, &c., were 'dibbed.' The young trees were almost touching each other, giving two belts or lines of healthy young saplings. As they grow up, the weediest and most scraggy will, from time to time, be eliminated, until, in course of time, there will be found a good shady avenue of well-developed healthy trees which, during their growth, will have afforded shade and protection to each other from wind, rain, heat, and frost. It is quite true that trees will not be at fixed intervals or in lines arranged with mathematical precision; but in growing them in the manner laid down above, we take a leaf out of the great book of Nature, whom we cannot copy too closely.' I give these remarks as I have not myself seen the localities, and cannot say, therefore, to what extent these experimental plantings are copies of Nature, which does not usually lay out avennes."

The Commissioner adds the following remarks :—

"This system (Mr. Faddy's) is not bad, provided that the thinning out is systematically and judiciously done. The fear is that it may be neglected, and that the young trees from overcrowding may be spoiled by not having room for lateral growth."

And he further adds, as regards the discontinuance of the former injurious method of pruning and lopping :—

"This was in consequence of a Circular issued by me last year. The instructions of the Circular had not, however, been at all intelligently carried out, as I observed in marching through the district in the cold weather. A great deal of thinning out is required in the avenues of this district. The trees are overcrowded, and for want of lateral space have grown up long and thin."

We hardly think this system is likely to prove a very good one for *road* avenues, but for such works as canal and railway plantations the system may turn out to be very useful. An interesting account of planting works in the Dera Ismail Khan district may be usefully extracted :—

"This District may be divided into three distinct tracts of country, in each of which a separate plan of operation in tree-planting must be followed. The three tracts are—

"(*i*). The 'Thall' or sandy desert stretching from the Katchi of the Indus to that of the Chenab.

"(*ii*). The 'Katchi' or low alluvial lands of the Indus running through the centre of the district from north to south.

"(*iii*). The 'Daman' or high land between the right bank of the Indus to the foot of the hills on the west. This tract is sometimes for a period of ten months blessed with no rain, when drinking water is a scarcity, and the people have to leave their villages with their cattle, and move to the banks of the river. Such a season of drought has just been experienced throughout this tract. At other times, however, especially in July and August, this portion of the district is sometimes so flooded with water from the numerous hill torrents, which intersect it from west to east, as to be quite impassable for several days at a time.

"The natural dampness of the soil, and the proximity of water to the surface, render the centre or riverain tract the most favorable of the three described for tree-growing, and there are few parts of the 'Katchi' where good shade of either the tali, the ber or the tamarisk cannot easily be met with. On the road between Bhakkar and Leiah there are stretches of avenues of old khagal, or tamarisk trees, frequently to be met with, which must have been planted in the early days of our rule when Leiah was the head-quarters of the district. Efforts have been made to renew these old avenues where trees are falling from age, and to extend them in some places by fresh planting, but the chief attention has been directed of late years to the treeless tracts of the Thall and Daman.

"Perhaps no more hopeless task ever presented itself than growing trees on such barren and waterless tracts as these, especially when it is considered how their natural difficulties, as regards soil, climate, absence of water and irrigation, are increased by the absolute want of real interest shown by all officials in the subject, and the apathy and indifference displayed by the people in the matter.

"On the Thall the only plan that can be followed in growing trees is first to sink wells, and thus secure the means of watering the trees fo the first year of their existence. This has now

been done along the main road across the Thall from Dera *vid* Bhakkar to the rail at Chichawatni. More than 60 wells are now completed, and held by people, who agree to maintain trees in the vicinity of their wells along the road on condition of holding their wells free of revenue. Nearly all these wells have now trees growing up about them on one or both sides of the road, and in this way shade is constantly met with by travellers across this sandy desert. Progress in a project of this kind must be slow, but, I think, sufficient success has been attained to justify further exertions in the same direction. Sometimes, however, prospects here appear very dark, when a season of drought, such as the one experienced for the last ten months, visits the district. In such times half the inhabitants desert the Thall, and tree-planting, and everything else connected with it, appear to decline rapidly. Much labor is lost, and much work has to be done over again. It is only by comparing the treeless state of the road a few years back, that one can see that still some decided progress has been made. Fortunately such seasons do not very frequently occur, otherwise it would be hopeless to attempt tree-planting across such a desert. The *tamarisk*, *ber*, and *kikar*, are the trees that grow best on this tract.

"The Daman country also offers few facilities for tree-planting. The rainfall is very scanty, wells are almost unknown, owing to the distance of the water from the surface, and its brackish character when reached, consequently the rearing of trees becomes a very difficult matter indeed. Operations have been confined to the two main roads leading from Dera to Bannu, and from Dera to Tank. They both run chiefly through the Daman. The same plan has, therefore, been followed in growing trees on both. Small 'katcha' tanks, with a depth of four to six feet, have been dug at intervals of a mile or so along the roads, and seeds and cuttings of hardy trees, as the tamarisk, ber and kikar, are sown and planted round their edge. The tanks collect the rain water of the ground for some distance round, and for a long time keep the soil in which the trees are growing moist, and enable them to be watered easily, and afford travellers drinking water until they dry up. In this way several groves of trees have grown up along both the roads above named. The method is simple and inexpensive, and more successful than any other I know for growing trees along roads on the Daman. Owing to an arrangement that has recently been made to bring down a permanent flow of water from the Gunmiah mouth to Dera, these tanks, whenever dry, can be refilled, and in this way a speedier and surer success may be expected to attend tree-planting operations on these roads, than could have been hoped for, had the tanks, as hitherto, still depended solely on rain water for their supply."

We have now pretty well exhausted the important items of

useful information given in these reports, but there are numerous minor points of interest worth recording, *e.g.*:

From Dera Ghazi Khan it is reported that kikar is very susceptible to frost when planted singly, though in clumps it stands fairly well! Is not this however the case with most trees? It certainly seems to us to be so with sal. In Hoshiarpur the aloe has been occasionally planted on roadsides, and as a fence to encamping ground, and is likely to prove profitable as the washed and picked fibre is found to realize Rs. 8 per maund in the Calcutta market.

We have so far omitted mention of distance planted, and financial results, as the information can only be given in statistical tables, which we have no space to reproduce; but we may state that up to April 1881 there were 3,614 miles of avenues in the Punjab. The receipt of the year were Rs. 29,875; the expenditure Rs. 1,05,695. From what funds this comes there is nothing in the reports to show.

The CANAL plantations are, in regard to forest work, more interesting to us than the roadside avenues; as besides avenues they have considerable areas of planted land. The works on the canals are of *two* kinds: *first* the avenues, and *second* the plantations. Of *avenues* there are now 2,266 miles as follows:—

	Miles.
Bari Doab Canal	... 364
Upper Sutlej „	... 301
Lower „ „	... 583
Indus Canal	... 110
Sirhind „	... 142
W. Jumna Canal	... 769
	2,266

And the results of the management are—

	Rs.
Revenue	... 39,790
Expenditure	... 29,532
Surplus	... 10,258

Why this surplus could not have been spent in doing more than 74 miles we cannot see, and the Conservator on this justly remarks that 74 miles is very moderate work considering that 656 miles remain to be planted.

Before leaving the subject of these *road* and *canal* plantations we wish to remark on the value of such work as is being done. We believe that similar work is being done in the North-West Provinces and Bengal, and that in the former of those two provinces, regular reports are published, giving outsiders some idea of results. We hope that the time is not far distant when every province will have its regular system of roadside, canal, and railway planting; and that the results will be systematically recorded and published. But the planting work should not stop at the spare lands of lines of communication but embrace all the waste land, the property of Government, available for planting as fuel and fodder reserves or as village forest. In

some places where Government has no waste lands, or indeed lands of any kind, perpetual leases might be taken, or purchase made of areas either unfit for cultivation or of poor soil, and reclamation as forest if only by mere enclosure which often alone suffices, effected. And if only Collectors and Deputy Commissioners could make the attempt, we feel sure that even the most treeless of the Indian plains would soon present a fair amount, if not of forest, at least of the vegetation.

Botanical Gardens and Parks of the Nilgiris.

We have received the annual report on the progress of the Government Botanical Gardens and Parks of the Nilgiris, for the year 1880-81. Much useful work has been done in the distribution of timber and fruit trees and seeds, and it is noted that *Cupressus macrocarpa* and *sempervirens*, and *Pinus longifolia* and *tuberculata* are now being planted out, where formerly only Australian Eucalypti and Acacias were in demand.

It is stated that Ootacamund is so overgrown with Australian trees that the view is limited to within a few yards of where the observer stands; and that on sanitary grounds it would be well if they were thinned.

The wattle is especially referred to as overrunning the hills with its dense undergrowth

Amongst fodder plants, the prickly comfrey and prairie grass are said to be the best in the Nilgiris, and the cocksfoot (*Dactylis glomerata*), and fescu grass are superior to all the other grasses which it has been attempted to introduce from Australia.

Cytisus proliferans (Tagasaste) is said to be very hardy, and to grow where nothing of value as fodder can succeed. It is, however, more relished by goats and sheep than by cattle.

The Ceara-rubber is growing well. Numerous applications for Jalap tubers are received from planters and its cultivation in the Nilgiris has succeeded perfectly.

Experimental cultivation in Mergui, British Burma.

Captain Butler, Deputy Commissioner of Mergui, British Burma, has made some experiments in the cultivation of coffee, cocoa, cardamoms, black pepper, vanilla, nutmegs, and tobacco, and the results are published with the approval of the Chief Commissioner in the *British Burma Gazette* for 22nd July.

Insects seem to be much feared at Mergui, and it is stated that a large proportion of the cocoanut trees there have been killed by a beetle which appeared seven years ago, and has done considerable

damage ever since. It is a large beetle, and destroys the young shoots at the head of the plant which it eats away, apparently when just sprouting. The leaves are thus jagged and torn, and cannot assimilate sufficient nourishment to keep the plant alive. We hope that specimens of the insect and its larva may be sent for the museum at the Forest School, and that one of our subscribers in Burma will kindly arrange this.

Liberian coffee appears to thrive, and 1,200 seedlings, planted out under the shade of large forest trees, are reported to be strong and healthy. About 9,000 other plants, which appear to be Arabian rather than Liberian, are doing well in the nurseries, and await the rains for being planted out. The cocoa plants have been largely destroyed by white ants and crickets, and only 60 out of 400 remain alive.

Cardamoms grow wild in the district, and form an article of trade amongst the Karens; and black pepper is also indigenous, but is not collected by the natives, who prefer the more pungent chilli, but Captain Butler states that its cultivation would be very profitable.

A large full grown plant of vanilla was received during the year from Singapore, from which upwards of 20 cuttings were taken and planted at the foot of large fruit trees, and one cutting is already 25 feet high, another 20 feet, the rest being from 5 to 8 feet in height. The Chief Commissioner, however, remarks that vanilla does better on bamboo trellis than on trees, where it gets too high, and there is more difficulty in getting the flowers fertilized, and the pods picked. He also states that vanilla requires a certain amount of sun.

Nutmeg seed has been obtained from Chinese gardens in Mergui, but only 12 plants were raised from 100 seeds. This was probably due to the seeds being insufficiently dried.

It is said that the nutmeg tree (*Myristica moschata*,) is a delicate plant, and requires care and time to raise. It comes to maturity in six to nine years, and then yields 2,000 to 3,000 nuts which would bring in Rs. 20 to Rs. 30 per tree. The fruit is merely dried in the sun and sent to market. Captain Butler, whilst walking round the plantation with Mr. Hill, Conservator of Forest, found a quantity of wild nutmegs, the fruit of *Myristica fatua* or *tomentosa*.

Some experiments in the cultivation of tobacco were also tried.

Annual Reports of Horticultural Gardens, Lucknow and Saharanpur, for 1881-82.

We have before us the Annual Reports of the Lucknow and Saharanpur Gardens. It is stated that acclimatized flower seeds, produced in the Lucknow Gardens, are much better than English seeds; and it is hoped, in the interest of gardening in India, that this fact may become generally known. The arboricultural nursery at Lucknow has not proved successful, only about 5,000 trees having been distributed, whilst the stock at the commencement of the year was over 100,000. Attempts to grow the Carob tree successfully appear to have failed. Four species of Eucalyptus are said to have been grown successfully, —two of these are *E. paniculata*, and *E. resinifera*. The names of the others have not been given.

Eucalyptus citriodora has seeded in the garden.

Pithecolobium saman is said to be making fair progress, one of the trees, planted out in 1879, being 12 feet high and 11½ inches in girth; but it would, however, have been 40 feet high and 36 to 48 inches in girth in Calcutta at the same age.

Arhar was sown in August 1880, in lines eight feet apart, the plants being eight to twelve inch apart in the lines, to protect seedlings from the frost. In the first year, owing to want of rain, little progress was made, and they afforded little shelter; but in 1881 they proved very useful, and during the cold season their tops were well grown together overhead, and afforded excellent shelter to the young mangoes. Arhar is said to be a cleaner and more wholesome plant than the Castor, but takes a longer time to be effective.

The Annual Flower Show at the gardens is said to have been very successful.

From the Saharanpur Garden report we see that the two hill gardens at Mussoorie and Chajuri are to be given up, and a new garden opened out in a more suitable locality. The Mussoorie Garden had a northern aspect, and was unsuitable for the growth of fruit. A fine collection of Japanese plants and bulbs were received in March, and included some rare conifers and *azalias* and other flowering shrubs and have been planted out at Mussoorie. Mr. Duthie brings to the notice of Government an Australian salt bush (*Atriplex nummularia*) which is said to thrive on salt soils, and to yield a valuable fodder. It will be experimented with in the reh infected soils of the usar reserves of Etah.

Under the head of fodder plants we hear that guinea grass has proved highly successful, and has yielded 600 maunds to the acre at a trifling expense.

Many varieties of English and American grass have been tried, but none are likely to outrival the indigenous *dub*.

The training of gardeners at the Saharanpur Gardens is an important item in their general usefulness. First class head gardeners were sent to Calcutta, Peshawar, and Amritsur during the year, and the demand for trained *malis* is greater than can be supplied.

Some interesting experiments in the growth of sal trees have been undertaken at the instance of Mr. Brandis, and the results are given below :—

Girth Measurement of Sal trees.

These measurements have been made in accordance with a wish expressed by Captain Wood, Conservator of Forests, Oudh Circle. Since that time a monthly record has been kept of the girth of a certain number of sal trees growing in this garden.

The trees of group I and II are, as far as I am able to ascertain, a little over 30 years of age. Those of group III are probably much older, but how much I am unable to say. The bungalow, beside which they are standing, was built in 1842 or 1843, and as these trees form part of an avenue leading from the bungalow to the high road, they cannot very well be more than forty years old.

In 1863 Dr. Brandis measured some of the sal trees in the Saharanpur Garden, and recorded the following results in the *Forest Flora*, page 27 :—

Age of trees.		*Girth.*		
13 years	..	27	inches	(average of 33 trees).
30 „	...	54½	„	„
35 „	...	69	„	„

Their respective ages would now be 32, 49, and 54 years. The three trees mentioned in group I of the following statement are, in all probability, of the same set as those mentioned by Dr. Brandis, as being 13 years old in 1863, and with a girth of 27 inches. During 19 years, therefore, the average growth has been about 16 inches. The periods during which the growth of each tree has taken place since January, 1881, are clearly brought out in the following table :—

Month.	I. Old brick hill.			II. Superintendent's compound.				III. Head Gardener's compound.	
	1	2	3	1	2	3	4	1	2
1881.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches	Inches	Inches.	Inches.
1st January ...	49½	45½	33½	62½	56½	56	48	67½	58½
,, February ...	49½	45½	33½	62½	56½	56	48	67½	58½
,, March ...	49½	45½	33½	62½	56½	56	48	67½	58½
,, April ...	49⅜	45½	33½	62½	56½	*56½	48½	67½	58½
,, May ...	*49½	*45½	*33½	*62½	*56½	*56½	48½	*67½	*59
,, June ...	49½	45½	*33½	*62½	*56½	*56½	48½	67½	*59½
,, July ...	*49½	*45½	*33½	*62½	*57½	56½	48½	*67½	*59½
,, August ...	*49½	*45½	*33½	*63½	*57½	*56½	48½	*67½	*60
,, September ...	*50½	*46	*34	*63½	*57½	*57	48½	*68½	*60½
,, October ...	*50½	*46½	34	*63½	*58	*57½	*48½	*68½	*60½
,, November ...	*50½	*46½	*34½	63½	*58½	*57½	48½	*68½	*60½
,, December ...	50½	46½	34½	*64	*58½	*57½	*48½	68½	60½
1882.									
January ...	50½	46½	34½	64	58½	57½	48½	68½	60½
February ...	50½	46½	34½	64	58½	57½	48½	68½	60½
March ...	50½	46½	34½	64	58½	57½	48½	68½	60½
April ...	50½	46½	34½	64	58½	57½	48½	68½	60½
May ...	*50½	46½	34½	64	58½	57½	48½	68½	60½
June ...	†50½	†46½	34½	64	58½	†57½	†48½	68½	60½

The leaves are shed during the month of March.
The trees are in full flower at the beginning of April.
N. B.—The figures marked with asterisks indicate growth; those with obelisks show decrease of girth due to contraction of the bark.

Poudrette Depot at Poona.

THE *Bombay Gazette* of the 7th September contains a report of considerable interest on the Poona Poudrette Depot, and the utilization of sewage.

The process adopted is the sun-drying one, which consist of exposing night-soil in shallow beds covered with ashes to the sun to dry, and when perfectly dried, in heaping it away to be sold to agriculturists as manure. The ashes are said to be the best disinfectant, and are prepared by burning street and house sweepings. It is said that, although seven years ago agriculturists would not touch the poudrette, its out-turn will not now keep pace with the demand, and that it

is used for all kinds of crops, and especially sugarcane; and the profit to the municipality in 1881-82 was Rs. 11,092. The quantity of poudrette applied to the soil varies for different crops, being from 1,350 to 2,700 cubic feet per acre for sugarcane, and 400 to 675 cubic feet per acre for rice and wheat. The net profits of sugarcane crops are increased from Rs. 20 without poudrette, to Rs. 75 with its use for inferior soils; and for better soils from Rs. 40 to 125 and for wheat from Rs. 3 to 4 or Rs. 5 to 6 per acre, rice being from Rs. 3 to 10 and Rs. 7 to 20. It is essential that irrigation water should be available. An alternative to the manufacture of poudrette is the dry earth system, dry earth being sifted and mixed with night-soil instead of ashes; the deodorisation was complete in two or three days, and the mixture ready for manure in five or six days. This process is much cheaper than the manufacture of poudrette, when the ashes have to be burned and sifted, and stored in sheds during the monsoons, but it is not liked by the cultivators who will only remove it with great reluctance.

One of the disadvantages of the poudrette system is that in burning the house and street sweepings, the best fertilizing organic matter is evaporated, which would be saved if the sweepings were sold as they are.

Mr. Moore, the Collector of Poona, in forwarding the report to Government, suggests that in each village near a canal, a sweeper and his wife, paid by Government, should be located, and that regular trenches should be opened for the villagers, and the contents mixed with soil, and eventually sold. In this way waste would be avoided, and the feeding of the cattle, pigs, and fowls on garbage be prevented. He further suggests that communal forests of *bábul* or other trees be established in each village near a canal, so that in course of time the villagers may have a plentiful supply of firewood. This, he remarks, is a sure way of providing for manure, because there would be no necessity to divert cowdung from its proper use as manure to that of fuel.

The contract system of disposing of night-soil is strongly condemned, as the contractor sells it before it is properly deodorised, and this practice is not only disagreeable but positively dangerous to human life.

The Commissioner regards Mr. Moore's suggestions as regards villages as impracticable, but surely something might be done in the direction of sanitation and communal forests.

Annuaire des Eaux et Forets pour 1882.

A COPY of this annual publication was received by us in May last, but has had to stand over until now. The plan on which it has been compiled is the same that has been followed for several years past, and we need, therefore, only confine ourselves to

drawing the attention of our readers to some of the more interesting facts which it contains.

The total area under the control of the French Forest Department at the comencement of the year was—

State Forests	... 2,465,451 acres.
Forests belonging to Municipalities and Public Foundations	... 4,840,986 „
Total	7,306,437 acres.

Given in square miles, these figures would be respectively 3,852, 7,564, and 11,416.

The area of the forests in Algeria is not stated, no doubt from their not being correctly known.

The area of France being about 202,000 square miles, the proportion of State Forests to the total surface of the country is roughly 1·9 per cent., of Municipal Forests 3·7, and of all the forests managed by the State 5·6—a very small percentage it must be admitted.

The whole area is divided into 36 conservatorships, the largest of which, EPINAL, comprises nearly 700 square miles of forests, and the smallest, RENNES, 76 square miles, the average extent being 317 square miles. This is equivalent to saying that, as far as mere area is concerned, a single forest division in the Central Provinces is equal to at least six conservatorships in France. Will the day ever come when the Central Provinces will have more than 100 conservators instead of the present single one?

The average annual revenue from the 3,582 square miles of State Forest during the ten years, from 1868 to 1877, has been £1,428,660, or nearly £400 per square mile, or more than 12 shillings per acre. In 1870, the year of the great war, the revenue was only £283,280.

The sanctioned expenditure for the current year is roughly £648,000, of which Algeria gets £62,400, and France proper, £585,600. This latter figure includes, besides other items, the following :—

Plantations, including the work in the Alps and in the Dunes of the Western Coast	£148,700
Roads and buildings	50,500
Total	£199,200

or about 34 per cent. of the whole expenditure. *Verbum sap.*

During the 10 years, from 1871 to 1880, the value of wood exported from France was £14,623,000, of wood imported £73,663,000. In other words, the excess of consumption over

production was £59,040,000 for the 10 years, or nearly £6,000,000 per annum.

The strength of the superior or commissioned grades of the French Forest Service is as follows :—

Director	1
Inspectors-General	6
Conservators	39
Inspectors	194
Sub-Inspectors	360
Gardes Généraux	268
Assistant Gardes Généraux	72
Total	940

or one officer to every 12 square miles. In India we have not even one Guard for that area.

The Central Forest Bureau in Paris forms a single department of the Ministry of Agriculture, and is divided into four branches. The first looks after the recruiting of the department, and the promotion and posting of the establishments, as well as controls the working of the other three branches. The second is charged with the direction of working plans (including forest surveys) and fellings and export of forest produce. The third branch controls plantation works and the construction of roads, canals, buildings, and machinery; while the fourth has the final audit of the accounts, and takes up all legal questions. At the head of each branch is a conservator, and the work of all four branches is controlled by an executive council composed of the Minister of Agriculture as President, the Director as Vice-President, and the six Inspectors-General as Members. The ordinary meetings of the Council are held every Wednesday at 2 P.M.

E. E. F.

Departmental Collection of Mohwa in Bombay.

AN important amendment to the Bombay Abkarry Act (Act V of 1878) was passed in the Bombay Legislative Council at Poona on the 28th June.

Its object is to regulate the collection and export of mohwa flowers, called in Bombay *mhowra*, which were being generally hawked about for the purpose of distillation, and this has given rise to an immense amount of unlawful action, and a large loss of revenue to Government.

By the Bill there will be no restriction in gathering the mohwa flowers, *i.e.*, between the 1st February and the 15th May, but only during the time the dried flowers are carried about for distillation.

It is said that mohwa is nowhere used as an article of food in the districts, Thana and Kolaba, to which the Act will now be applied. It is, however, used by the Bhils of Khandesh when prepared in a particular way with flour; but they are only said to use it when hard pressed, and then they eat all kinds of roots, and other jungle produce as well. The Bhils, therefore, exchange the mohwa flowers with Banias for other things rather than use them for their own consumption. In this way the Bhils do not receive the full value of what they have collected, and they will be greatly benefited by the new Act, which directs that the mohwa shall be collected departmentally from the Bhils, and sold to the liquor distillers.

Speaking of the collection of myrabolams, and quoting from a report by Colonel Peyton, Sir James Fergusson says, that the Bhils of Belgaum, as well as those of Kanara, showed the greatest good will, and expressed themselves very grateful for the introduction of the system they had been asking for, *viz.*, the departmental collection of myrabolams. The very liberal payment provided for the collection of myrabolams by the Forest Department enables men and women to earn four to six annas, and children two to four annas daily, on their own and neighbouring village lands from November to May every year, and draws the hill people and other classes, who formerly preyed on the forest by chopping and collecting firewood, towards the department by their common interests. Colonel Peyton's statement is confirmed by the Collector of Sattara, and in the Northern Division the estimated revenue from myrabolams is nearly two lacs of rupees.

Arguing from the experience in the departmental collection of myrabolams, which has become far more remunerative to the poor than when they had no market, but by barter with the bania, the Governor shows that by regulating the collection of mohwa flowers the people will be greatly benefited. By the new law the possession of dried mohwa flowers, without a license, will be considered an offence, and Government will purchase all the flowers from the districts where the mohwa grows, and export them to the markets outside those districts.

In tracts, however, where mohwa flowers are used for food, provision of limited quantities will be permitted. The chief argument used in favour of the amendment of the Act was the great falling off in Abkarry revenue in the Thana district, where the average revenue in the inland talukas from 1871-72 to 1876-77 was Rs. 1,33,000, and in 1880-81, after a great deal of illegal distillation of mohwa flowers, the revenue sunk to Rs. 1,20,000, and in 1881-82 to Rs 76,000, and had thus been reduced by 40 per cent in three years; and in spite of this reduction the increase of drunkenness was so great that the strongest measures were suggested, even to cut down all the *brab* and toddy trees on Government land.

Since a stricter system has been introduced by raising a high duty on tree tapping, and limiting the number of stills and liquor shops, the improvement of the district is very great. Those who formerly spent their last farthing in liquor have now a little balance to spend on some little comfort or another, and all employers of labour can now get a fair day's work for a day's wages, which they could not succeed in doing before.

In preventing the illicit distillation of mohwa the police had frequent and serious conflicts with the people, and murders and dacoities are said to be much less where the new Abkarry Laws are enforced.

The opposition of the native members of the Council to the measure was unanimous. The danger of interfering free trade was brought forward; it was stated that mohwa was an article of food; that Government was being made a catspaw by the farmers of the Abkarry revenue; that the Abkarry officers were already too powerful, and would, by this Act, have still more power to harass every man, woman, and child of the lowest of the people.

It was urged that Hindu law makes forests, hills, rivers, sacred temples, seas, and tanks free property of the public which shows that forest rights exist from time immemorial. It was also contended that the export of mohwa flowers to France last year was to the extent of four lacs of rupees, and that it was very detrimental to the interests of the country to impose restrictions on this rising trade.

But this opposition was met and overruled, though not silenced, by Sir James Fergusson's clear statements, and the amendments were carried by the official members of the Council.

JY. TIMBER MARKET.

PRICES CURRENT IN JULY.

Rangoon Teak.

Mast Pieces, good large	... Rs.	5 to 12 per running foot	... Quotations nominal.
Sawn Timbers ...	... „	80 to 100 per ton	... Ditto.
Planks, long lengths	... „	110 to 120 do.	...
Sheathing Boards, ½ inch	„	110 to 120 do.	... Ditto.
Ditto ¾ inch			
Boards 1 inch	... „	105 to 120 do.	...

Moulmein Teak, &c.

Square Timbers, 20 to 29 feet long, 10 to 13 inches square, first-class	Rs.	90 to 120 per ton of 50 cubic feet.	
Ditto, 20 to 45 feet long, 14 to 18 inches square	... „	120 to 175	ditto.
Second-class Timber ...	... „	90 to 98	ditto.
Planks, long lengths, first-class	... „	110 to 120	ditto.
Furniture Planks, 18 to 36 inches broad, and 1 inch thick—good	... „	130 to 150	ditto.
Sheathing Boards, ½ inch, double	„	130 to 135	ditto.
Ditto ¾ inch	... „	110 to 140	ditto.
Scantlings (of sizes) ...	... „	60 to 125 per ton.	
Moulmein Cedar, Square Timber	... „	65 to 70 „	
Thingan and Consohr	... „	45 to 50 „	Nominal.
Peemah	... „	55 to 63 „	

American and other Timber.

Mahogany	... As. 6	per supl. foot of 1 inch thick.
Sal	... Rs. 65 to 110	per ton.

Stock of Teak in Calcutta on 1st August—5,729 tons.

—*Mackenzie, Lyall & Co.'s Circular.*

PRICES IN BOMBAY DURING JULY.

Bamboos	per 100	...	... Rs.	16	0 0
Firewood	„ maund	...	... „	0	9 0
Timber Teak	„ cubic foot	...	... „	3	0 0
„ Jungly	„ „	...	... „	2	3 3

PRICES AT BYRAMGHAT IN OUDH.

Sal Beams	per cubic foot	... Rs.	2 10	to Rs.	3 0
Scantlings	„	... „	2 0	to „	2 8

We have noted the prices of firewood throughout India, quoted in the Gazette of the 9th September, and give the highest and lowest rates in each Province :—

			Seers per Rupee.
Madras ...	...	Tinnevelly ...	... 82
„ ...	...	Ganjam ...	... 216
Bombay ...	...	Bombay ...	... 62
„ ...	...	Haiderabad ...	... 320

		Seers per Rupee.
Bengal	Jalpaiguri	65
„	Howrah	80
„	Chittagong Hill Tracts ...	320
Assam	Cachar	80
„	Kamrup	200
North-West Provinces ...	Mirzapur	100
„ „ ...	Garhwal	280
Oudh	Fyzabad	120
„	Hardui	240
Punjab	Delhi	80
„	Kangra	140
„	Shahpur	320
Central Provinces ...	Raipur	60
„ ...	Chanda	360
Behar	Ellichpur	64
„	Secunderabad	125
Coorg	„	110
Rajputana	Ajmere	70
„	Meywar	200
Central India ...	Gwalior	109
„ ...	Goona	200

Prices in Burmah are not given.

It will be noted that the highest rates are quoted at Raipur in the Central Provinces, and this is due to the exhaustion of the forests in its vicinity; but matters should surely be changed by improving the communications, as there are large forests at no great distance, and at Chanda, in the Central Provinces, firewood is quoted at a lower rate than at any other place in India.

It would be interesting if the rates for fuel, prepared from cowdung in the different provinces, were quoted in the *Gazette of India*, side by side with those for firewood.

V. Notes, Queries, and Extracts.

Agilwood.—In one of Messrs. Mackenzie, Lyall & Co.'s Circulars Agilwood occurs, and we should like to know the scientific name of the tree which yields it.

In the "Treasury of Botany" it is said to be synonymous with Eagleswood, or Aloeswood, and the produce of a tree from Sylhet, probably from the Garo Hills, *Aquilaria agallocha*. The wood is said to contain abundance of resin and an essential oil, and to be highly esteemed as a perfume. It was burned in the palace of Napoleon I. on account of its fragrance.

When in the Garo Hills I heard of a very valuable wood for incense, and that formerly it had been exported, but that the demand had ceased of late; is this the same wood? We shall be greatly obliged if the forest officer in the Garo Hills would make enquiries and send us botanic specimens of the tree, and a piece of the wood.

Collections of Indian Timber.—Government orders have been issued for a fresh collection of Indian woods for the Brussels Economic Museum.

Divisional officers, who are entrusted with these numerous collections for Vienna, Paris, Melbourne, Italy, Belgium, &c., must wish that their work could be done once for all; but no sooner are the specimens named and despatched than they are met with fresh demands.

What has become of the surplus timber from the collection for the Paris Exhibition which Government had arranged to keep to meet future indents?

The select committee appointed to consider the Madras Forest Bill have returned the Bill amended by them to Government, and it was published in the *Fort St. George Gazette* for the 19th August, and with a few more amendments was finally passed by the Madras Council on the 26th August. Mr. Sullivan, in presenting the Bill, stated that in it it had been provided that Government should have power to lease private forests, the management of which it was considered necessary to regulate; but if the owner were unwilling to make such an arrangement, he should be able to require Government to acquire such forests under the Land Acquisition Act.

Mr. Carmichael, in seconding the Bill, remarked that the select committee had informally met Mr. Brandis and discussed with him the main alterations in the Draft Bill, and that in conse-

quence of this discussion some amendments to make the Bill more workable were to be proposed.

After some discussion, in the course of which several amendments were agreed to, and the rules for the conduct of business having been suspended, the Bill was passed unanimously.

We hope to review the Madras Forest Act in our next number. We quote as follows from the *Pioneer* with reference to the Madras Forest Bill :—

"Speaking at Courtallum recently, His Excellency the Governor of Madras defended this Bill, which has been lately passed by the Madras Legislative Council. 'I can assure you,' he said, 'that all care was taken to prevent any sort of oppression of the ryot by forest officers, or any one else; but there are some people with whom a disinclination to be oppressed means an inclination to consult their own interests, combined with a grand contempt for the interests of others. They cut down or burn trees, which belong to the public, just as it suits them, thus destroying the natural distributors of rain, and giving a new sense to the ill-omened saying of an European statesman—'After me, the Deluge.' I do not think that the people of this district will be slow to acknowledge the benefit which this, the Forest Act of 1882, will, ere many years are over, have conferred upon them."

A great number of notices of lands taken up as reserved forests have appeared in the *Bombay Gazette*, but owing to their length we are unable to give them in our columns.

By order of Government, dated 28th July, forest officers on duty will be entitled to the actual cost of conveyance of their horses and tents, in the same manner as other public officers, in addition to their authorised travelling allowance.

From the speech of Lord Enfield, at the distribution of prizes at Cooper's Hill, we learn that three of the six candidates selected for the Indian Forest Department will, for the future, be trained at Cooper's Hill, the other three attending the Nancy Forest School as heretofore.

We hope that provision will be made for those attending classes at Cooper's Hill becoming thoroughly acquainted with continental forest management. It is not from experience learned in the forest of Dean, the new forest, and the Scotch fir forests of North Britain, that they will acquire a very elevated ideal of forest management; and if men are to be sent from Great Britain to India for the forest service, we have a right to ask that they should have visited the finest European forests,

and have had some experience of the most scientific forest management.

Otherwise it would be preferable to train them in forestry in India after they have learned some physical science and engineering at Cooper's Hill; and the Dehra Dun Forest School is already competent to undertake this.

But when we consider the great demand arising for foresters in the Colonies, it is a subject for congratulation that a commencement has been made in attempting to teach scientific forestry in England, even though the means for instruction by well managed and mature forests, under all varieties of circumstances of climate and soil, is so scanty.

We have received the monthly meeting report for August of the Agricultural and Horticultural Society of India, and note that Cacao cultivation, though a failure in Bengal, is likely to succeed in Ceylon, where the quality of the Cacao produced is said to be excellent, and to approach that of Trinidad.

Eucalyptus citriodora is doing well in the Society's garden, and it is hoped to render its cultivation easy in Bengal by means of acclimatized seed.

A case of 600 crotons was despatched to Saharanpur by train without any earth whatever, and at a total cost of Rs. 15, including telegrams, baskets, freight, cartage, &c.

The plants arrived in very good condition, and this promises well for the dissemination of these beautiful foliage plants in our Indian gardens.

A Piece of Good Work.—Sir Arthur Hobhouse has brought to a close a very good and solid piece of public work, in the arbitration which commenced on the 8th of August 1878, for settling the valuable and complicated interests involved in the Epping forest controversy. The necessity for the arbitration arose in this way: For a great many years the lords of the forestal manors were in the habit of effecting enclosures of the open waste for their own benefit, and of selling them to whoever would buy. All efforts made by the commoners to stop such proceedings failed, till the year 1871, when the Corporation of London, who had some rights of common, instituted a Chancery suit, which was brought to a successful issue in the year 1874. By the decree in that suit the enclosures were found to be illegal, and those which had been effected within twenty years from the institution of the suit became liable to abatement. But large quantities of enclosed land had been made the sites of houses and gardens, which it was impossible to deal with by the strict legal method. It would shock the moral sense to pull down a man's house in order that a cow

might graze upon its site. Some arrangement, therefore, was necessary to moderate the legal right, as well as for disentangling other knots created by the illegal enclosures and the decree of 1874. The matter was first referred to a Parliamentary Committee, who devised a plan by which the grantees of enclosures were to be left in possession, on terms to be worked out through the medium of juries in compensation cases. The plan was rejected by Parliament, who, in the year 1878, threw the whole of the affairs into the hands of a dictator, with a few simple directions to guide him on some points, and absolute and unlimited discretion on all others.

The main outlines of the scheme of 1878 are as follows :— Epping Forest is to be preserved henceforth for the joint benefit of the public and the commoners. The Conservators of it are the Corporation of London, acting by a committee on which are placed the four elected verderers of the forest. Enclosures prior to the 14th of August 1851, however illegal, are sanctified by antiquity. The arbitrator is ordered to throw open all subsequent enclosures, except the following—houses and gardens, such portions of land as he may think it reasonable to allot to a residence, nursery gardens which he may think not to be prejudicial to the public interest, and small plots which the conservators and the arbitrator may concur in thinking not to be required for the public. The arbitrator is to impose what conditions he thinks fit on the retainer of enclosures. He is to say how and when the enclosures shall be thrown open. When thrown open, he is to settle what shall be paid to their possessors. The lords of manors are to sell their wastes to the conservators at whatever price the arbitrator fixes. A host of subordinate questions are referred to him, the most important of which probably are the historic controversy whether the inhabitants of Loughton have the right of lopping trees over about 1,000 acres of waste, and, when that was decided in their favour, on what term the right should be bought up. By a subsequent Act, passed in 1880, the arbitrator was directed to make a map showing the operations in the arbitration, and the ultimate state of the forest. He was also empowered to effect exchanges of forests land for other land.

The questions have been worked through by the conservators, who have held the brief for the public and the commoners, and by Sir Arthur Hobhouse, sitting as arbitrator, in the space of four years. And the time will not appear long if we consider that the dispute has ranged over property of enormous aggregate value ; that it has affected a number of properties and interests, little if at all short of 1,000 ; that the questions have been of a most delicate and irritating kind—namely, how much land shall be taken away from a man, how much he shall be allowed to keep, how much he shall pay for what he thought to be

his own, or receive for what is forcibly taken from him ; and that these delicate questions had to be solved, not by strict law, though exact knowledge of the law was a necessary preliminary, but by discretionary principles invented for the purpose of moderating the law under the novel and peculiar circumstances of the case.

The conservators, the arbitrator, and the proprietors may all be congratulated on the extreme smoothness with which the arbitration has worked—a result which could not have been obtained without patience and industry on the part of the two former, or without good sense and feeling on the part of the latter. And the Londoners may be congratulated on the close of a long and sore wrangle, and on securing some 6,000 acres of open space at a moderate price. It is worth mentioning that Sir Arthur Hobhouse has performed this important and laborious task for a fee which, under the circumstances, is hardly more than nominal.—*S. James' Gazette.*

An Ivory Famine.—Notwithstanding the introduction of "celluloid" and other substitutes for the real article, the demand for ivory increases year by year, and year by year the supply falls off. Not only is the quantity of elephant ivory, both from Asia and Africa, rapidly diminishing, but the teeth or tusks of the walrus, whale, and narwhal, which are so highly prized for many purposes where their fine texture and close grain render them superior to elephant ivory, are similarly growing scarcer every year. If it had not been for the large supplies of fossil mammoth ivory which we have received from Siberia—the relics of a bygone age, when Northern India was the playground of monster tusk-bearing, elephant-like animals, whose bodies, suddenly overwhelmed by an avalanche of ice, are still to be met with, kept in a state of perfect preservation by the most powerful and efficient refrigerating machinery of Nature herself—if it had not been, we say, for this extensive, but necessarily limited, source of supply, the price of ivory would be much larger than it even now is, when a plain ivory-paper-knife of ordinary size, after passing through the necessary cutting and polishing operations, is worth half a crown an ounce. The *Engineer* reports that the rapid advances in the value of ivory are causing some uneasiness in the market. At the last quarterly sale, which closed on the 28th ultimo, there were only 81 tons offered, as against 122 tons offered in April 1881. The falling-off was mainly owing to the continued scarcity of Cape, and the limited supply of West African ivory, of which altogether only 12 tons were forthcoming. From Zanzibar and Bombay there were 33 tons, 24 tons from Alexandria, and 9 tons from Malta. Prices consequently have gone up from 3*l.* to 4*l.* per cwt. The stores in the docks this

year amount to 133 tons, compared with 213 tons for the corresponding period of last year. One importer at Sheffield has received 522 tusks, which, he says, will all be cleared out in a fortnight. These tusks represent 276 elephants, and it is argued that, if one ivory-cutter alone can get through so many in so short a time, there is some fear of the elephant being relegated to the lost genera of animals. It is time that some steps were taken for the preservation of this valuable animal in Africa similar to those which have been adopted in India and Ceylon, and the authorities in our West African colonies might turn their attention to the possibility of devising some means to attain this object. In the meantime, cannot some inventive genius discover the means of utilizing the scraps and shreds of ivory which ivory-turners necessarily produce in such quantities, either by reducing them to a pulp, and pressing them into the desired shape or into powder, which may be afterwards solidified?—*Colonies and India, 19th May.*

New India-rubber Plant.—Some months ago the Civil Surgeon of Kurrachee, Dr. Adey, had his attention drawn to certain Indian plants capable of producing India-rubber. Of those he experimented upon, he found that the *Cryptostegia grandiflora* was the only plant which produced juice in a sufficient quantity to make it worth while to use as an India-rubber-producing plant. The results of his experiments led to a discussion in which the Superintendents of the Botonical Gardens at Gunesh Khind, Saharunpore, and Calcutta took part. The Government has now come to the conclusion that a new and more extended trial of the plant is necessary, and that Mr. Birdwood should co-operate in the experiment. With this view the Commissioner in Sind has placed a sum of Rs. 100 at Mr. Birdwood's disposal to enable him to conduct the experiments on a proper scale. It is understood that a sample of the rubber, obtained from the *Cryptostegia grandiflora* will be sent to England to test its quality, and to ascertain its market value.—*Indian Daily News.*

Mr. T. Christy of London on India-rubbers.—*London, 14th June* 1882.—Sir,—I see that a question is asked on page 450 of your weekly edition of the *Ceylon Observer* as to the best manner of getting the India-rubber out of the different rubbers of the *Landolphia* species, and also enquiring when it is likely to come to maturity.

I have studied the habits of the *Landolphias* from the west coast of Africa for about three years, and have taken every information I could gather respecting them; and, after considerable difficulty, obtained one plant of *Landlophi Kirkii*

from Kew. This last plant has made its growth, and I can see that its habit is very similar to *Landolphia florida*.

Because the Indians obtained the rubber by tapping the trees, that is to say, by cutting holes in the bark and catching the juice, it is no reason why this course should be followed, when it is necessary to obtain the juice from a different class of tree to the *Ficus elastica*. If any of your readers, who are growing this species of *Landolphia*, will take a dead bough or "runner," and cut it through the bark up to the stem without quite severing the piece, they will find that it is full of gum, and so elastic in quality that, if the woody piece of bark is separated, and the *gum* fibre left, it will spring back to its former position, carrying the bark with it.

This tree throws up every year runners from the roots, and, in my opinion, it is advisable that these should be allowed to mature, and that, when they can be cut down, it will be necessary to find some process for extracting the rubber from the dry bark or from the stems. With this aim I am trying some experiments, but I need hardly add under what difficulties I labour in this country, only being able to obtain such small pieces. I have written over and over again to the west coast for branches and trees to be sent over to me, but my correspondents say that I have no idea of the expense and trouble of sending into the woods for these faggots, and then having to transport them through the surf to the steamers which lie in the roadsteads. There are plenty of substances that will melt the India-rubber, but the object is to find a chemical that can be relied upon, that, when treated, will return a commercial product in the pure state of "gum elastic."

It must be also noted that, if any experiments are tried, the strength of the spirit should be recorded, for some strengths will melt the resins as well as the rubber.

Very little is as yet known respecting the rubbers that come to the London market further than that the merchants classify them as they can turn them to commercial purposes. I have placed before a man, who knew rubber at sight, three samples, all taken from the same tree, the juice or milk having been treated differently. He could hardly believe that the native form which he was accustomed to purchase could be treated so as to yield a clean, clear gum. This proves what may be done by careful collection.—*Tropical Agriculturist.*

THE INFLUENCE OF LIME IN THE GERMINATION OF SEEDS.—Some interesting results of experiments by Dr. Liebenberg, as to the influence of lime on the germination of seeds, have recently been published by that gentleman in the Journal of the Vienna Academy of Sciences. It appears that the seeds of many plants require the presence of lime in the soil during the germinating process, or the seedlings die for the want of it.

It is shown also that many other plants do not fail to germinate freely and well without the presence of lime in the soil. Dr. Liebenberg also points out that plants, which fail to grow through the absence of lime in the soil, do not fail in consequence of the injurious effects of any other matters that may be present, but because lime is essential to their healthy growth.—*North British Agriculturist.*

The Timber of British Columbia.—Professor Dawson, of the Dominion Geolgical Survey, in a report on the forests of British Columbia, draws attention to the vast importance of the timber supplies of the Province. He states that many first-class mills have been established in various parts of the country, and the total annual product is stated to be about 200,000,000 feet, of which 25 million feet are exported to other countries, 25 million feet used at home, and 150 million feet sent to California. He estimates that 110 million acres (or two-thirds of the whole Province) are covered with timber. The Douglas fir, or Oregon pine, is the most valuable commercial tree. It frequently exceeds eight feet in diameter, and rises to a height of from two to three hundred feet, forming great and dark forests. The western hemlock and the red cedar are the next most important trees of the Province, both of them, the latter specially, growing to a great size. The importance of these vast reserves of timber, as well as of the mineral resources of the Province, will become more apparent as settlement extends westwards from Manitoba towards the Rocky Mountains. The construction of the Canada Pacific Railway will also develop the mineral and timber resources of the Province.—*Colonies and India.*

Insects injurious to forest and shade trees.—By A. S. Packard, Jun., M. D. Bulletin No. 7 of the United States Entomological Commission. We think it might have been better had the author somewhat modified the title. Every insect known to feed upon a particular tree is treated upon. In his introductory remarks the author states that Kaltenbach enumerates 537 species of insects as injurous to the "oak" in Europe; a very large number are given as injurious to the same tree (using the term in a broad sense) in America. It is obvious, when we come to analyse this list, that only a very small proportion of these are strictly noxious insects, and then only when they occur in extraordinary numbers, which is only occasionally. It is natural for certain caterpillars to feed upon certain plants, and the damage they occasion is in proportion to their number. We have to deal here only with trees, and beyond the unsightliness caused by occasional destruction of foliage on a large scale, we doubt if the trees suffer permanent injury from leaf-feeding larvæ. Naturally a certain amount of functional disturbance must

result; but surely an equal or greater disturbance arises from judicious pruning or lopping, even although it is usually carried out at the season of least functional activity. Our author, however, regards these insects as "parasites," not specially injurious, adding that the deadly forms are comparatively few. Probably under this latter limited class he includes some of the wood or bark feeders. He is possibly right in some instances, but we feel sure that the morbid conditions, commonly attributed to the presence of lignivorous insects, are more frequently due, in the first instance, to "something wrong at the root," inducing an unhealthy state which the insects seize upon just as flies attack carrion, or visit an ulcer on a beast's back.

At this moment a lady (Miss E. Ormerod), eminently qualified for the position, has received the distinction of being appointed honorary entomological referee to the Royal Agricultural Society—the first time that economic entomology has received any official recognition in this country. She can, and doubtless will, do much good (as she has already done) in enlightening our agricultural classes as to the nature of the insect pests that trouble them, and by instilling into their minds the axiom that "prevention is better than cure." Keep up a vigorous state of health, and the damage caused by insects will occasion little anxiety as a rule, and to this end the advice of an economic entomologist should mainly be directed. But there are exceptions, and when these assert themselves in an extraordinary degree (as will sometimes happen), we fear the only thing is "to grin and bear them."—*Gardeners' Chronicle.*

We see from a letter to the *Tropical Agriculturist* by Mr. Bernays, dated House of Parliament, Brisbane, 1st June 1882, that *Cedrela toona* is indigenous in Queensland, and is attacked there by grubs at the terminal shoot in the same manner as in this country.

Guttapercha (*Gutta Taban, &c.*)—This name* is applied to the concreted or inspissated juice of various plants belonging to the natural order *Sapotaceæ*, growing in the Malay Peninsula. To what particular tree the name "guttapercha" properly belongs there is no evidence to show; but it has been generally given to *Dichopsis gutta* (Bentley and Trimen) or *Isonandra gutta* (Hooker), the vernacular name of which is "taban." †

The *Dichopsis gutta* attains a height of 60 to 80 feet, with a diameter of two to four feet. The leaves are obovate-oblong, and

* Gutta, or as it is variously written gutah, gatta, gittah, gatta. is the Malayan term for gum, and percha (pronounced as in perch, not hard as perka), accentuated variously as parcha, pertja, percha, is the name of the tree, hence the term may be translated "gum of the percha tree." The old name of Sumatra was Pulo or Pulau percha, *i.e.*, "island (Pulau) of the percha tree."

† Tuban, tuban, taban, is the name of the tree, and according to Logan, a new word has been added to the Malay language *viz.*, Menaban (Men [t] aban), *i. e.*, to collect gutta taban. The greater number of Malay nouns admit of conversion into verbs by a prefix.

entire, pale green on the upper side, and covered beneath with short reddish-brown shining down. The flowers are arranged in clusters of three or four in the axils of the leaves. The fruit, about an inch long, is of an ovoid shape, and is eaten by the Malays. In Siak (Sumatra) a vegetable butter is prepared from the seeds. The wood is soft, fibrous, spongy, of a pale colour, and marked with black lines, these being reservoirs of guttapercha.* The gutta, as it flows from the tree, is of greyish hue, occasionally with somewhat roseate tinge, probably arising from the colour vessels of the bark becoming ruptured through surcharge and their contents mixing with the gutta. This species does not furnish all the guttapercha of commerce; indeed there are other trees which yield larger quantities. In all there are about thirty varieties known; but some of the vernacular names in different districts may prove mere synonyms.

The geographical distribution of the trees producing guttapercha is very restricted. Gutzlaff defines the limits as 6° N. and S. lat., and 100° to 120° E. long; whilst Captain Lingard (who has great personal experience on the subject) gives the limits as 4° N. and 3° S. lat., still further restricting the finer varieties to 3° 50′ N. and 1° S., with a temperature ranging between 66° and 90° Fahr., and a very moist atmosphere. These limits are well within the isotherm of 80° Fahr. Many of the best varieties are found only on the hill slopes at a distance from the sea-coast, each variety forming a separate grove of from 200 to 500 trees, with high forest trees above them. They grow best in a rich light loam, with a rocky subsoil.

The collection of guttapercha generally takes place directly after the rainy season, as in the dry season the gutta does not flow so readily, while during the rains ague and jungle fever are most prevalent, and the gutta is liable to be washed away from the felled trees. The yield of a well grown tree of the best variety is from 2 to 3lb. of guttapercha, such a tree being about thirty years old, 30 to 40 feet high, and one-half to three feet in circumference. A full grown tree sometimes measures 100 to 140 feet to its first branches, with a girth of 20 feet at a distance of 14 feet from the base, and may yield 50 to 60lb. of guttapercha, which loses in six months about 35 per cent of its weight in drying.

The methods of extracting the guttapercha are much the same amongst the Malays, Chinese, and Dyaks. The trees are cut down just above the buttresses, or *banees*, as they are called; and for this purpose a staging, about 14 to 16 feet high, is erected. The tools used in felling are either "billiongs" or "parangs." A billiong is a kind of axe used by the Malays in felling, building, &c. The blade is of chisel-like form, and the tang is secured at right angles to a handle by means of a lash-

* For figures and botanical descriptions see *Lond Journ. Bot.*, 1848; De Virese, *De Handee in Getah-Percha*; and Bentley and Trimen's *Medicinal plants*, part 35, p. 16 (1878).

ing of "rattan" or cane. The Chinese sometimes use an axe perfectly wedge-shaped. The parang looks more like a sword-bayonet, and, in the hands of a Malay, is a box of tools in itself, as with it he can cut up his food, fell a tree, build a house, or defend himself.

When the tree is felled the branches are speedily lopped off, to prevent the ascent of the gutta to the leaves. Narrow strips of bark, about an inch broad and 6 inches apart, are then removed, but not all round the tree, as its underpart in its fall becomes buried in the soft earth, much sap being thus lost. Some natives beat the bark with mallets to accelerate the flow of milk or gutta. The milk flows slowly (changing colour the while) and rapidly concretes, and, according to its source, may vary from yellowish-white to reddish or even brownish in hue. The gutta, as it flows, is received into hollow bamboos, doubled up leaves, spathes of palms, pieces of bark, cocoanut shells, or in holes scraped in the ground. If the quantity obtained is small, it is prepared on the spot by rubbing it together in the hands into a block, in one end of which a hole is made to carry it by. In this state it is known in the market as "raw gutta" or "gutta muntah." If water gets mixed with the juice, the gutta becomes stringy and is considered deteriorated, but after boiling appears quite as good. Sometimes the gutta is kept in a raw state for a month or two, and then undergoes the next step in the preparation, that is, boiling. The boiling is generally conducted in a "kwali" or pan of cast or hammered iron, of about 15 inches in diameter and 6 inches deep. The boiling is either simply with water, or with the addition of lime juice or cocoanut oil. If one pint of lime juice be added to three gallons of gutta juice, the latter coagulates immediately on ebullition.

On arriving at the port of shipment the gutta before exportation generally undergoes examination and classification into parcels, according to quality. As received in the godowns or warehouses it presents great diversities in condition, shape, size, and colour,—from crumbling, hardly coherent, whitish or greyish "raw" or "getah muntah" fragments, to reddish or brownish blocks as hard as wood. Sometimes it is made up into all manner of grotesque shapes of animals, and it is nearly always largely adulterated with sago-flour, sawdust, clay, stones, &c. The Chinese are great adepts in assorting and classifying gutta, and frequently prepare from different varieties a certain "standard sample," by cutting or chopping the material into thin slices, and boiling with water in large shallow iron pans, keeping the contents constantly stirred with poles, and adding good guttapercha, and even cocoanut oil to give a better appearance. When sufficiently boiled the gutta is pressed into large moulds, and is then ready for shipment. This process of reboiling is wholly unnecessary, and in some cases, is done only

to get rid of stuff which has no right to be called "gutta-percha."

The amount and value of guttapercha imported into Great Britain in 1875-77 were as follows:—

	1875.	1876.	1877.
Cwts...	19,686	21,558	26,359
Value	£149,684	£163,441	£238,327

The price of guttapercha ranges from 4*d.* to 3*s.* per lb., according to quality and demand.

Many substances have been recommended as substitutes for, or as supplementary to, guttapercha. Among these Balata gum undoubtedly holds the first place. It is obtained from the *Mimusops Balata* (Gartner), a tree found in British and French Guiana, Jamaica, &c. Professor Bleekrod seems to have been the first to direct attention to this substance, by bringing it before the notice of the Society of Arts in 1857. The Balata gum combines, in some degree, the elasticity of caoutchouc with the ductility of guttapercha, freely softening and becoming plastic, and being easily moulded like guttapercha. What small parcels have been sent to England have met with a ready sale, and were remarkably pure and free from adulteration. But unfortunately, through the difficulty of collection, the occupation being dangerous and unhealthy, the supply of this excellent article has fallen off. It is procured by making incisions in the bark of the tree about seven feet from the ground, a ring of clay being placed around to catch the milk as it exudes. A large tree is is said to yield as much as 45lbs. of "dry gum." *Pauchoutee*, the produce of *Dichopsis elliptica*, Collins (*Basia elliptica*, Dalzell), is a most interesting substance, and may yet prove an article of commerce if properly treated. At present, although by heat it becomes plastic and ductile, it is brittle and resin-like when cold. The tree is found very generally distributed in Wynaad, Coorg, Travancore, &c.

Many of the *Euphorbias* yield milky juices which have some at least of the properties of guttapercha. The chief amongst these are the Cattimandoo (*Euphorbia Cattimandoo*, Elliot), and the Indian spurge tree (*E. tirucallis*, Linn.) of India, and some *Euphorbias* at the Cape of Good Hope. The alstonia or pala gum (*Alstonia scholaris*, R. Br.) and the mudar gum (*Calatropis giganteo*, R. Br.), have also been recommended as substitutes for guttapercha. But the attempts made to utilize these substances have as yet been unsuccessful.

Future Supplies.—A very important matter for consideration is the question of the future supplies of guttapercha. It is after all only a spontaneous natural product. If a Malay or Chinese wishes to plant pepper, gambier, &c., he burns down a portion of the forest, and, when he has raised two or three crops, he clears a new portion, and thus finely-wooded spots become denuded of trees, and covered with rank grass rendering them

unfit for further cultivation. Again, to obtain the gutta-percha, the trees are cut down and none are planted in their stead, so that in districts where they were in abundance one or two only are now preserved as curiosities. It is a wonder indeed that a single tree is left. A writer in the *Sarawak Gazette* says that from 1854 to 1875 over 90,000 piculs (of 133⅓lb each) of guttapercha was exported from Sarawak alone, and this meant the death of at least 3,000,000 trees. In fact the only thing that preserves the tree at all is that it is of no use to cut one down till it is 25 to 30 years old. Sooner or later recourse must be had to cultivation and conservation.—*Encyclopædia Britannica.*

In our last number we gave (p. 81) an account of the proposals made by M. Grandeau to reorganize the forest service and forest superior staff in France. We now read in the *Révue des Eaux et Fôrets* that a decree of the 1st August has already made an important step towards the projected change, though rather differently from M. Grandeau's proposals. Under the new order, the students of the Forest School as they pass out will at once become "Assistant-Inspector," while the grade of Guard-General will, in future, be filled by officers who have passed at the Subordinate Schools.

The forest are to be divided into 240 inspections, to be managed by Inspectors or Assistant-Inspectors; and the pay of the different grades is to be as follows:—

		£	£	
Inspectors	4 classes from	160	to 240	per year
Assistant	6 „ „	80	to 152	„ „
Guards-General	5 „ „	56	to 104	„ „

It may be remembered that the old rates were:—

	£	£
Inspector	160	to 240
Sub-Inspector	104	to 156
Guards-General	72	to 88

so that the new arrangement gives rather higher pay at first to junior officers, and permits large increments in proportion, but on the whole does not very much improve the general pay of the department.

VJ. Extracts from Official Gazettes.

1.—Gazette of India—

No. 592F.—14*th July* 1882.—The undermentioned Sub-Assistant Conservators of Forests are appointed to officiate, until further orders, as Assistant Conservators of Forests of the 3rd Grade, with effect from the dates mentioned :—

Mr. H. G. Young, Assam, from the 1st June 1882.

Mr. R. L. Heinig, Bengal, from the 15th June 1882.

No. 619F.—22*nd July* 1882.—*Mr. J. Copeland*, Sub-Assistant Conservator of Forests in the Punjab, is appointed to officiate, until further orders, as an Assistant Conservator of Forests of the 3rd Grade, with effect from the 28th June 1882.

No. 717F.—25*th August* 1882.—*Mr. J. S. Battie*, Sub-Assistant Conservator of Forests in the North-Western Provinces and Oudh, is appointed to officiate until further orders as an Assistant Conservator of Forests of the 3rd Grade, with effect from the 16th August 1882.

2.—Gazette of North Western Provinces and Oudh.—

No. 481—10*th July* 1882.—*Mr. R. J. P. Pinder*, Sub-Assistant Conservator of Forests, in charge of the Bahraich Division, Oudh Circle, leave to Europe on medical certificate for five months, with the usual subsidiary leave.

No 519.—26*th July* 1882.—*Mr. J. C. Murray*, Sub-Assistant Conservator of Forests (Officiating Assistant Conservator, 3rd Grade), attached to the Tons Division of the School Circle, three months' examination leave, to enable him to study for the Higher Standard in Hindustani, from the 1st August 1882.

3.—Punjab Gazette.—

No. 318.—27*th July* 1882.—In exercise of the powers conferred upon him by Section 51 of Act VII of 1878, the Hon'ble the Lieutenant-Governor is pleased to declare that Rule IV, published under Notification No. 341F., of 31st August 1879, is hereby cancelled, but only so far as regards the river Jhelum. On the said river, in lieu thereof, the following rule shall henceforth be in force :—

Rule.—The Forest Officer in charge of the Jhelum Division may authorise zaildars, lambardars, or other respectable persons to salve timber which is adrift at any point on the river below the last catching place, and may cancel such authority.

The amounts payable for the salvage of such timber delivered at any drift timber depot, which may be notified by the Forest Officer under section 45 of the Act, shall be the same as the amounts payable according to the contract, if any, for the salvage of Government timber in force at the time of the delivery of the salved timber at such depôt, or, in the absence of any such contract, and in any case not provided for by such contract, shall be between Jhelum and Khushab, at the rate of five rupees eight annas, and between Baghan and Jhelum, at the rate of three rupees six annas per 100 cubic feet of contents.

No. 350.—16*th August* 1882.—*Mr. L. C. Smith*, Officiating Assistant Conservator of Forests, Beas Division, has

obtained three months' examination leave, under section 53 of the Forest Department Code, with effect from the forenoon of the 24th July 1882.

4.—CENTRAL PROVINCES GAZETTE.—

No. 2406.—*1st July* 1882.—*Mr. Muhammad Anwar Khan*, Sub-Assistant Conservator of Forests, transferred to the Central Provinces by Government of India Notification No. 316F., of 19th April 1882, is attached to the Nimar Forest Division.

Mr. Muhammad Anwar Khan joined the Nimar Division and assumed charge of his duties on the forenoon of the 15th May last.

No. 2580.—*15th July* 1882.—*Mr. G. F. Taylor*, Officiating Assistant Conservator of Forests, posted to the charge of the Saugor Division, by Notification No. 2276 of the 26th June 1882, assumed charge of that division from *Mr. G. H. Foster*, Officiating Deputy Conservator of Forests, on the afternoon of the 4th current.

No. 2581.—*15th July* 1882.—*Mr. R. H C. Whittall*, Deputy Conservator of Forests, availed himself, on the afternoon of the 5th current, of the one year's furlough granted him by Notification No. 1828 of the 26th May 1882, making over charge of the Nimar Division to *Mr. H. B. Anthony*, Officiating Assistant Conservator of Forests.

No. 2582.—*15th July* 1882 —*Mr. G. H. Foster*, Officiating Deputy Conservator of Forests, transferred to the charge of the Nimar Division, by Notification No. 2276 of the 26th June 1882, assumed charge of his duties on the afternoon of the 8th current from *Mr. H B. Anthony*, Officiating Assistant Conservator of Forests.

No. 3009.—*9th August* 1882.—The Chief Commissioner is pleased to invest *Mr. E. D. M. Hooper*, Assistant Conservator of Forests, Chanda, with powers of a Magistrate of the Third Class, to be exercised within the limits of the Chanda district.

No. 3010.—The Chief Commissioner is pleased to appoint *Mr. E. D. M. Hooper*, Assistant Conservator of Forests, Chanda District, to be a member of the Chanda District Fund Committee.

5.—BRITISH BURMA GAZETTE—

No. 63.—*6th July* 1882.—Under the provisions of section 3 of the Burma Forest Act, 1881, the Chief Commissioner specially empowers *Mr. M. J. Slym*, Deputy Conservator of Forests, Salween Division, a Magistrate of the Third Class, to try forest offences.

6.—ASSAM GAZETTE—

No. 194.—*19th July* 1882.—*Mr. W. E. d'Arcy*, Assistant Conservator of Forests, made over charge of the Lakhimpur Forest Division to *Mr. E. Ludlow*, Assistant Conservator of Forests, 1st Grade, on the afternoon of the 9th July 1882.

No. 200.—*20th July* 1882.—Certain alterations having been made in the distribution of forest charges in Assam, the names of the officers in charge, their desig-

nations and head-quarters, the names of divisions, and the old forest divisions and districts included in the new divisions, are hereby notified for general information. The new designations only should be used in future in accounts and all official correspondence.

No.	Officer in charge.	Designation.	Head-quarters.	Division.	Old forest divisions and districts included in the new divisions.
1	G. Mann, Esq. ...	Conservator	Shillong ...	Direction	Direction.
2	D. P. Copeland, Esq.	Assistant Conservator ...	Tura ...	Gáro Hills	Gáro Hills district.
3	J. T. Jellicoe, Esq. ...	Deputy Conservator ...	Dhubri ...	Goálpára	Goálpára Forest Division and Goálpára district.
4	A. J. Mein, Esq. ...	Assistant Conservator ...	Gauháti ...	Kámrup	Gauhati Forest Division, the Kámrup district, and the Jirang and Nongpung Forests in the Khási Hills.
5	T. J. Campbell, Esq....	Sub-Assistant Conservator	Tezpur ...	Darrang and Nowgong ...	Tezpur Forest Division and Darrang and Nowgong districts.
6	C. G. D. Fordyce, Esq.	Assistant Conservator ...	Sibságar ...	Sibságar	Sibságar Forest Division and Sibságar district reserves in the Nága Hills district under Act VII of 1878.
7	E. Ludlow, Esq. ...	Assistant Conservator ...	Dibrugarh ...	Lakhimpur	Lakhimpur Forest Division and Lakhimpur district.
8	H. G. Young, Esq. ...	Sub-Assistant Conservator	Cachar ...	Cachar	Cachar Forest Division and Cachar district.
9	.....	Deputy Commissioner ...	Sylhet ...	Sylhet	Sylhet district.
10	.....	Ditto ...	Shillong ...	Khási and Jaintia Hills ...	Khási and Jaintia Hills district.
11	.....	Ditto ...	Kohima ...	Nága Hills	Nága Hills district.

August 12th

Rubber Mahal Sale Notice.

Notice is hereby given that the right to extract rubber from rubber-trees in the Eastern Duars (which comprises the rubber mahal of this district) will be put up to auction for the period beginning on the 1st January and ending on the 30th April 1883, at the Deputy Commissioner's Cutcherry, on the 1st of October 1882, at noon.

The following are the conditions with which the lease will be sold:—

1. The lease confers a right to tap trees for rubber only within the boundaries specified, and not beyond them.
2. The lease does not confer the right to tap rubber-trees growing along roadsides, near temples, or in other public places, or on private lands within the boundaries specified.
3. The lease confers no right to foreign rubber, and does not authorise the lease to interfere in any way with private or foreign rubber, or with persons conveying it.
4. The trees must be tapped only in the months of January, February, and March; the month of April being included in the lease to permit of the collection of the produce by the lessee.
5. The roots of the trees and the lowest part of the stem, within 3 feet from the surface of the ground, are not to be tapped, and no trees are to be felled or burned, or their branches cut.
6. The incisions shall not be less than 2 feet apart, and must not exceed 1 foot in length, and 4 inches in breadth.
7. Half the amount for which the lease is sold must be deposited on the day of sale, and the other half on or before the 1st March.
8. The lessee shall be responsible for all breaches of the above conditions, whether committed by himself or by persons in his employ.
9. The lease will be liable to be cancelled, and the amount deposited forfeited, in case of breach of any of the conditions of the lease; and if the trees are tapped otherwise than as permitted by the lease, the lessee or his agent will be liable to prosecution for mischief under the Indian Penal Code.
10. The lease will be sold to the highest bidder, but the Deputy Commissioner has power to refuse to accept any bid even if it be the highest.
11. If the license is cancelled, owing to the breach of any of its conditions, the Deputy Commissioner has the power of re-selling it for the remaining period, at the risk of the first purchaser, who shall be liable for any loss occurring from resale.
12. If called upon to do so, the auction purchaser must give security for the due payment of the second instalment of the revenue.
13. Further and fuller information can be obtained from the Deputy Commissioner before the day of sale.

Boundaries of the Rubber Mahal.

North.—Bhutan Hills.
South.—Parganas Khuntaghat, Purbutjoar, and Ghurla.
East.—Monas river.
West.—Godadhur and Sunkos rivers.

7.—Bombay Gazette—

3rd July 1882.—*Mr. C. L. Gibson*, Deputy Conservator of Forests, Belgaum, received over charge of the District Forest Office, Ratnágiri, Kolaba, on the 22nd May 1882, before office hours.

No. 4483.—11*th July* 1882.—*Mr. F. R. Desai*, Deputy Conservator of Forests, acted as Conservator of Forests in Sind from 10th April to 9th May 1882, both days inclusive.

18*th July* 1882.—*Mr. G. M. Ryan*, Acting Assistant Conservator of Forests, Khándesh, handed over charge of his office to *Mr. W. G. Betham*, District Forest Officer, Khándesh, on the 6th July 1882, after office hours, and proceeded to Bombay in pursuance of the orders of Government Resolution No. 4362, dated 6th instant, Revenue Department.

No. 4855.—24*th July* 1882.—*Mr. F. R. Desai*, Deputy Conservator of Forests, 3rd Grade, to act, as Deputy Conservator of Forests, 2nd Grade, and *Mr. W. G. Betham*, Assistant Conservator of Forests, 1st Grade, to act as Deputy Conservator of Forests, 3rd Grade, with effect from the 10th April 1882, during the absence of *Major McRae* on furlough, or until further orders.

No. 4921.—26*th July* 1882.—*Mr. G. A. Hight*, Assistant Conservator of Forests, N. D., has been allowed by Her Majesty's Secretary of State for India an extension of furlough for fourteen days. *Mr. Hight* has also been permitted by the Secretary of State to return to duty within the period of his leave.

No. 68.—27*th July* 1882.—*Mr. T. H. Aplin*, Assistant Conservator of Forests, 1st Grade, is appointed to officiate as Deputy Conservator, 2nd Grade, during the absence of *Captain C. T. Bingham* on furlough, or until further orders, with effect from the 22nd June 1882.

No. 69.—27*th July* 1882.—*Mr. E. P. Popert*, Deputy Conservator of Forests, availed himself of the furlough granted to him in this Department Notification No. 18, dated the 14th April 1881, on the 11th May 1881.

No 4982.—28*th July* 1882.—*Rama Hari*, Revenue and Police Patel of Jalsar in the Máhím Táluka of the Thána Collectorate, who was sentenced by the Second Class Magistrate of Máhím on the 27th May 1881 to three months' rigorous imprisonment for having cut down trees in a Government forest, is declared ineligible for employment in the Government service in any capacity.

No. 5119.—2*nd August* 1882.—*Mr. A. D. Wilkins*, Assistant Conservator of Forests, 2nd Grade, is promoted to the 1st Grade, with effect from the 3rd April 1882.

No. 5541.—16*th August* 1882.—The following extract from a Report, No 179, dated 7th ultimo, from the Superintendent, Government Model Farm, Bhadgaon, Khándesh, relative to the working of an improved sugarcane mill, employed on that Farm, is published for general information :—

3. "The sugarcane mill, which has been beyond comparison the

most successful of all the different patterns tried here, was made by the late Firm of Nicol & Co., Bombay, in imitation of the large mills built by Messrs. Onie, of Glasgow, for use in the West Indies, and differing from them, besides size, in one particular only, that of having the level wheel on the upright shaft of the mill working *underneath* instead of *over* the corresponding wheel on the end of the upper roller.

4. This mill is in cast-iron with three fluted rollers (14 inches long by 10 inches in diameter,) *one* above, *two* fitted at the one end by even-toothed wheels which work into each other, the lower being turned by the upper, which, as above stated, is connected with the upright shaft. In the cross head of this shaft poles are fixed, and the bullocks pulling in a circle, at the ends of those levers communicate motion to the mill.

5. This machine is constructed so as to work with a maximum of economy in this district as much as it exactly consumes the power of two pairs of bullocks, and fully employs one cutter, one feeder, one delivery man, one cook, and one kettle: working continuously, it produces 12 maunds (of 82lbs.) of Jagri per day, and thus clears two to three acres of crop weekly.

6. Its cost in 1868 was Rs. 650, but the iron market was at the time abnormally high. The price at present rates would be about Rs. 500.

7. The people are particularly fond of this mill, but of course no individual could afford to buy it for his own special use, and the want of facilities for getting done any trifling repairs of iron work, deter *Wanias* or other capitalists from investing in them, That such an investment would pay is proved by the fact that it was hired to neighbours last year at Rs. 1-4 per day, and realized from this source Rs. 82. In the preceding year its earnings amounted to Rs 173.

8. The makers of this at the same time built a few mills of a combined pattern. These have three iron rollers as in the above, but placed in a line perpendicularly, and in a wooden frame like the country *Ghani*. They can be made for Rs. 350, and act very well for a time, but readily give way under the pressure of work, so that the saving on original construction is soon outbalanced by the heavy expense of frequent repairs."

8—MADRAS GAZETTE—

August 8th, 1882.—*Mr. T. Maduranayagam Pillai*, Forest Ranger, 3rd Class, Satyamangalam Range, Coimbatore Division, is granted privilege leave of absence for one month, under section 71, Chapter V, of the Civil Leave Code, from date of availing himself of the same.

September 12th, 1882.—*Mr. Rowson*, Assistant Superintendent, Cinchona Plantations, Naduvatam, has been permitted to resign his appointment, with effect from 1st July 1882.

Mr. T. Narayanaswamy Nayudu, Head Overseer and Acting Assistant Superintendent, to be Assistant Superintendent, *vice Mr. Rowson*, resigned.

Mr. H. Hillier, Office Manager and Acting Head Overseer, Dodabetta, to be Head Overseer (on probation.)

Mr. V. A. Parthasarathy Mudaliyar, Head Clerk, Deputy Conservator's Office, Nilgiris, and Acting Manager, to be Manager until being relieved as per Notification (*Fort St. George Gazette*, dated 18th July 1882). These appointments to take effect from the date of *Mr. Rowson's* resignation.

In the Forests Notification, dated 11th July 1882, published in the *Fort St. George Gazette*, dated 18th July 1882, Part II, page 826—

For "Head Clerk in the Office of Deputy Conservator of Forests, Nilgiri Division—"

Read "Head Clerk in the Office of the Deputy Conservator of Forests, Nilgiri Division, and Acting Manager, Cinchona Department.

September 12th.—Mr. S. A. Newman, Forest Ranger, 2nd Class, to be Forest Ranger, 1st Class, North Arcot Division (with effect from 1st September).

Mr. W. R. Newman, Forest Ranger, 2nd Class, Nilambur Division, is granted leave, without allowances, for six months, under Section 133, Chapter X, of the Civil Leave Code, from 20th August 1882.

Mr. T. A. Maduranayagum Pillai, Senior 3rd Class Ranger, to act as 2nd Class Ranger during the absence of *Mr. W. R. Newman* on leave, or until further orders.

Mr. W. P. Rego, Head Clerk, Nilambur Forest Office, to act as 3rd Class Ranger, until further orders.

THE

INDIAN FORESTER.

Vol. VIII.] DECEMBER 1882. [Nos. 3 & 4.

Translation of Amenagement des Forets par M. Puton.

TRANSLATOR'S PREFACE.

THE purpose and scope of this work is sufficiently indicated by the notice prefixed to the second edition of the original.

"Two subjects," says the author, "must be known in order to undertake, efficiently, the management of a forest estate: 1*st*, the *cultivation* of the species of which the forest growth is composed; 2*nd*, the *preparation of plans for working*, and the mechanism of such plans."

These two branches of forest knowledge,—sylviculture and "aménagement," or the art of drawing up working plans,—are intimately connected: one helps and illustrates the other, but each has its own distinct line.

This work presupposes that the student has studied the subject of sylviculture as described in special works devoted to it.

The object at present is not to teach or even to indicate the different processes which are necessary to be gone through in order to draw up a scheme of working. This procedure is described in a treatise prepared by M. Nanquette, the learned Director of the Forest School at Nancy.

Still less does the author attempt to state theories or discuss doctrines. These are special works which deal with such matters, among which may be mentioned the "Etudes sur l'Aménagement des Forets" by M. Tassy.

The object, thus strictly limited, of the present work is to indicate the mechanism of the methods usually employed in drawing up schemes of working, to explain, in short, what an "aménagement" or scheme for working is; and how the accounts of the yield and working of a forest are made out on the basis of the working scheme.

This is a matter of practical administration, and it is important to carry into the working of forests those ideas of accounting for everything, and showing the effect in profit and loss, in stock, and pecuniary yield, which are just as necessary in the case of public estates as they are in the management of private property.

Elementary books ought to be limited to this practical view of things rather than attempt a survey of scientific principles too often incomplete in themselves.

PART I.
General Notions of Forest Economy.

Chapter I.—Of the Exploitation of Forests Generally.

Capital of exploitation, or growing stock.—In order to work (or derive the appropriate products from) a given estate stocked with forest, just as in the case of land bearing crops, or with grazing ground or meadow land, there must be a *stock* which economists speak of as the *capital* or *material of exploitation.* In agriculture, this capital consists of the farm buildings, the seed grains, the cattle, and the agricultural implements: part of this consists of fixtures, and is immovable; part is movable. In the case of forests, the whole stock is immovable. If we take the case of a coppice to be mature for cutting at 20 years of age, the stock is represented by a growth of trees in a graduated scale extending for 1—20 years in age. In the case of high forest, mature at say 120 years, it is a growing stock in a scale of ages from 1—120 years.

This statement at once brings to notice the difference which exists between forest property and agricultural property. In agriculture if the proprietor manages badly, and is obliged to wind up his estate, he cannot ordinarily dispose of his farm buildings without parting with the land also. By themselves, the buildings have no value. In the case of forest property, on the contrary, the owner would be able to convert into money the entire timber growth, apart from the land, and the land so denuded would remain, though unable to make any return in timber, till such time had elapsed as was necessary for nature to reproduce a new growth of trees ready to be felled.

This leads me to remark how necessary it is for a public administration to watch over the due conservation of the stock in forest estates, whether they belong to the State, or to communities, or to public institutions, since these bodies, as proprietors, are not like individuals who may do what they like with their own, but are "legal persons" (*êtres moraux*) having a perpetual existence in the eyes of the law, and, therefore, the individuals composing them at any given moment, cannot deal with the estate as if it were their property. They are only in fact the enjoyers of the usufruct, and are bound to hand down to their successors the estate itself, with its stock or capital, unimpaired.

The public interest would suffer unreasonably if for any cause, even one of great present emergency, the capital were seriously attacked, since we cannot restore full grown trees, as we can put up new and complete buildings, even with the most liberal outlay of money. Time alone—and that in most cases a very long time—can restore the forest capital once destroyed.

Another point of difference may also be noted. In agriculture a proprietor who is in want of money can sell his cattle, his ploughs or his carts. For ordinarily these implements find ready purchasers in other agriculturists, who can apply them to working their property—they are in fact transferred to another estate; that is all. The individual may suffer, but society is not affected. A forest proprietor, on the contrary, is always under the temptation to sell a portion of the trees that constitute the scale of ages necessary as a capital for a proper exploitation:* if he does so a double misfortune results. In the first place, the material is not transferred to another estate, there to be used productively; it is consumed and serves for no further productive purpose: there is then a positive diminution of the timber-producing agencies in the country. In the second place, a large additional stock of firewood or timber being thrown into the market, the supply may exceed the demand. The production may not stand in a proper relation to the consumption, and the price consequently falls; the public interest then suffers, since the neighbouring forest proprietors cannot obtain a remunerative price for *their* wood. Trades which consume wood are, for the moment, supplied cheaply and abundantly, but have to pay dear for this later when wood becomes scarce; and, lastly, a precious material has been made cheap and squandered, there being no means of replacing it, since time alone, not human effort, can produce it.

There is no need of agricultural science to be aware that in all countries agriculture may be conducted on the large or on the small scale. One man works with a small plot of land with simple hand implements, and manure bought retail in the market. The other works with extensive ranges of buildings, with steam-machinery and a considerable extent of land. It is possible also to classify forest cultivation into major and minor.

You have HIGH FOREST or timber cultivation where the trees are reproduced from seed; and the COPPICE, where the reproduction is by shoots from the stool or root-stock.

This division corresponds to that of forests working with an extensive capital of exploitation, and working with a limited capital.

Trees that are to be reproduced by seed do not usually produce good seed, till they are of considerable age; and thus to work on the basis of a high forest you must have a long scale of ages, and consequently a large area of land and a great mass of growing material.

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* The author remarks that in French the term "*exploitation*" is sometimes used to mean merely the work of cutting trees, logging or sawing them up, and clearing them out of the forest. He is using the word here (and mostly elsewhere) in the economic sense (in which we follow him) of getting the produce or interest-value out of anything, working a commercial, industrial (or forest) enterprise, so as to obtain the desired result in yield or proceeds.

When you work by coppice, the shoots grow up in a comparatively short time, and you have a shorter scale of ages, and can work with a smaller area.

Let us take as an illustration the case of two estates, each of 300 acres, treated one as coppice, with a rotation of 20 years, the other as high forest at 120 years.

I. *For High Forest.*—Let us suppose that an acre of forest produces 800 cubic feet* at the age of 120 years. The capital will be formed by a series (total 300 acres) of compartments or divisions of the area occupied: severally, by trees of ages from 1—120 years, and the value of solid wood in each, will follow a scale of 0 in the youngest to 800 cubic in the oldest. The mean or average will then roughly be 400 cubic feet. We can then represent the standing stock or capital as $300 \times 400 = 120{,}000$ cubic feet.

II. *For Coppice.*—Supposing one acre of coppice at 20 years to yield 66 cubic feet. The capital similarly constituted as above, and with a rough average of the contents, will be $300 \times 33 = 9{,}900$ cubic feet.

A timber producer, who wished to work his estate of 300 acres by high forest, must then have a constituted capital of 120,000 cubic feet of growing timber, while one who was content to work by coppice, could exploit the same area with a producing stock of nearly twelve times less.

In order then to work for high forest, the proprietor must be very rich; and, speaking generally, it is only the State or, great public institutions or commercial bodies that are able to afford the large capital necessary; and, further, it is only such bodies that are rich enough to be beyond the temptation of from time to time making inroads on the capital, or that are rich enough to wait while the capital is being built up by process of time.

Speaking generally, we may say that private forest property can best be worked on the coppice-plan, and that it is only States and institutions that are imperishable that can afford to work high forest.

There are other reasons also leading to the same conclusion. Agricultural products are always the same whether they come from cultivation on the large or on the small scale. They always consist of grain, fodder, or cattle. In forest property it is otherwise. Forests worked on the "petite culture," or as coppice, yield only small wood, wood for charcoal, and faggots. It is high forests alone that can give planks, railway sleepers, and timber for purposes of construction. Now both the one class of produce and the other are equally necessary to the country; and as there are not, as a general rule, proprietors rich enough to have, and above all to *maintain permanently*, high forests yielding timber of large size, the State and public institutions are bound in the interest of the public welfare to keep up forest estates capable of supplying the community with this most indispensable material.

* That is feet of solid wood, not merely wood in stack. This solid measure is spoken of in France as "*en grume*." The measure applied to firewood in stack when the external measure represents a block partly of space, partly of wood, as the *stere*.

Quantity of Material produced.—The sum total of valuable products (and consequently the material wealth of the country) increases, notably by means of forest (high forest) cultivation on the large scale. Let us return once more to the two examples already given, and which we shall keep to in order that our reasoning may be more readily followed.*

We assume that on coppice treatment an acre would produce 66 cubic feet at 20 years of age; that is about 3·3 cubic feet per acre per annum $\frac{66}{20}=3{\cdot}3$ cubic feet. Valuing this (roughly for the purposes of the example) at annas 12 a cubic foot, the product would be annually about Rs. 2-8.

But for an estate treated as high forest we should have the annual production per acre:—

$\frac{6\,7\,0}{1\,0\,0}$ cubic feet $=6{\cdot}7$ cubic feet. Valuing this large sized timber at Rs. 1-4 a cubic foot, the result would be—

6·7 cubic feet × Rs. 1-4 = Rs. 8-6

(Add 15 per cent. thinnings valued as coppice)

1·3 cubic foot × 12 As. = „ 1-0

Total... „ 9-6

It has been calculated that if all the forests in France were treated as high forest, then production of wood would be raised by 15,000,000 of cubic metres, and by 290,000,000 francs in value.

But out of 8,000,000 hectares (roughly 20,000,000 acres) of forests which exist in France, about one million hectares (2,500,000 acres) belong to the State, and two millions (5,000,000 acres) to the Communes.

And there are about five million hectares (12,500,000 acres) of private forests nearly all worked as coppice.

Income.—Why is it then, since high forest produces so much more both in mass of timber and in money than coppice, that private proprietors hold so much to coppice and own so little high forest? The reason is very simple. The private proprietor works only for his own immediate advantage: he does not look to the production of a class of wood required by the country at large; nor does he feel himself under any obligation to find labour for the labouring classes, or material to supply the various trades and industries. He only produces wood because he finds forest a safe and paying investment. Let us return to our former example, and make out an account.

* The ages selected 20 for coppice and 120 for high forest are chosen arbitrarily for examples only. As a matter of fact the rotation for coppice usually varies from 30 to 35 years according to kind. It takes also 150 to 200 years to produce an oak or a silver fir (*Ab. pectinata*) of large dimensions, and even 300 years for the full growth of the Larch in some parts of the Alps. As a matter of fact therefore, a rotation of 120 years would be too short for high forest. The instances, however, are taken as convenient for example.

Let us take the soil as worth about Rs. 40 an acre.
Then for coppice :—

(1.)	Soil 300 acres @ Rs. 40 ...	Rs.	12,000
(2.)	Wood produced 9,900, valued at As. 7 for wood in process of growth	„	4,331
	Total	„	16,331

The annual products are (300÷20) or 15 acres yielding 66 cubic feet of mature coppice, valued at As. 12 a cubic foot, or Rs. 743 (about). His yearly income then is Rs. 743, on a capital valued at Rs. 16,331, or say 4½ per cent.

For high forest we should have the capital :—

Soil as before	Rs.	12,000
Wood 120,000 cubic feet, valued at As. 14 in a growing estate	„	1,05,000
Total	Rs.	1,17,000

The annual products are—

(1.)	(300÷120) or 2½ acres yielding 800 cubic feet @ Rs. 1-4 ...	Rs.	2,500
(2.)	The value of intermediate thinnings calculated @ 15 per cent., say 120 cubic feet @ As. 12=	„	90
	Total ...	„	2,590

His yearly income is thus only a little over 2 per cent.

It is evident then that high forest, although producing nearly three times as much in material, and five times as much in money as coppice, yields a smaller interest to the proprietor, when we compare the capital respectively engaged in each method of production.

In the present state of society few persons are rich enough to enable them to be content with two per cent. or less on their money ; and if any existing proprietor should be so well off, we may be sure that such a state of things will not last beyond two or three generations.

Not to mention possible reverses of fortune, the division of family property is quite enough to upset a calculation in which time and fixity are indispensable conditions.

A private proprietor would also reason as follows :—

The owner of a high forest of 300 acres, with a growing stock of 120,000 cubic feet, could easily realize the conditions necessary to work the same on the coppice method : that is to say, he would have 120,000 cubic feet—9,900 or 110,100 cubic feet. This stock (rather over the value of ordinary coppice) let us take as worth As. 14½ ; the value will be in round numbers Rs. 98,000. So that with this sum in money he could purchase nearly six

times as much coppice, (since 300 acres coppice was in our example worth Rs. 16,331).

He could then acquire —

(1.)	His old coppice forest of 300 acres worth	Rs. 16,331	producing	Rs. 743
(2.)	New coppice forest of 1,800 acres worth	97,986	„	4,458
	Total ...	2,100 1,14,317		5,201

So that instead of 300 acres of high forest, worth Rs. 1,17,000 and bringing in Rs. 2,590, he would have 2,100 acres coppice worth Rs. 1,14,317, and bringing in Rs. 5,201, or seven times more land and double the revenue; and that with security exactly the same, and under the same general method of investment.

What private proprietor then could hesitate to prefer coppice to high forest?

But compare this result so favorable to the individual proprietor, with its results to the country at large. The 2,100 acres of coppice will only yield (at 3·3 cubic feet per acre) 7,000 cubic feet of wood annually for consumption and use in industry; whereas worked as high forest, the same number of acres would produce (at our already shown rate of 6·7 cubic feet per acre) 14,070 cubic feet of material of far higher value, not only in money, but by the amount and usefulness of the labour which can be employed on it.

The advantage of the high forest treatment is that it supplies to the country at large, more than twice as much in the elements of employment of labour and industry, and five times more in the elements of utility and exchange. But these are advantages which are of value only to the public, not to the private proprietor, whose only care is to invest his money for his own benefit.

It has followed in France, that the timber forests formerly possessed by the feudal nobility and the Church, which were confiscated at the Revolution, and all the State forests which have since been (from time to time) alienated, have with rare exceptions been diverted from their original treatment, and converted into forests worked "à petit capital," or coppice forests,—the only ones which the means of private owners will permit them to follow.

Let us also bear in mind that the working capital and growing stock of a forest destined to produce timber of large size, if once destroyed, is incapable of speedy reconstitution, unlike that of a farm or that of a manufacturing business. With sufficient money these latter can be restored in a single year. But in a forest, spend what you like, and you must still have a century or more to restore your capital.

It will now be obvious to the reader that the interest of private owners is *against* the conservative treatment and work-

ing necessary to the high forest method, and that private owners are *incapable* of being the continuous producers of timber of large size.

*Position occupied by State Forests.**—The economic requirements of private property just considered have been further confirmed by successive modifications in the law relating to private property.

The ancient law of succession tended to preserve intact, in certain families, large patrimonial estates; but this is now a thing of the past, and all property is equally liable in law to indefinite partition.

The ancient customary law also, while it made timber trees immovable property, and as it were a part of the soil, saved them from the destruction caused by the creation of usufructs and other temporary modes of enjoying property; nothing now restrains the enjoyment of any kind of property, but the terms of the contract.

The Marine service had in private forests a right of pre-emption, or prior claim to purchase certain timber of large size. This was abolished in 1837, but it had, while it existed, the effect of encouraging the production of timber in State forests for the benefit of future generations.

It is only in the nature of things that such restrictions should disappear before the progress of a democratic society, whose characteristics are a vast expansion of industry and trade.

In France then, as in most modern societies, it is only corporations or bodies, having a legal existence which never terminates, that are rich enough, and long-lived enough, to devote their forests to the production of large timber, which national industry can never dispense with, notwithstanding the increased employment of iron for constructions.

But in respect of these institutions there has also been much change.

Under the ancient monarchy there were three classes of legal or moral bodies, having an unlimited right of holding property. They were—the State, the Commune, and the Church. The latter has lost, since the revolution, the right of holding property, at least as far as religious communities are concerned. The State and the Commune alone remain. The great commercial and Financial Companies, do not come under this category; they are, in fact, much more like associations finding capital and labor, than associations for saving or amassing property, and besides that they are very far from being imperishable.

Centuries ago, an ancient and national legislation subjected the

* The reader will remember that this is a translation from a French work. The reason for the existence of State forests is therefore based on consideration of the law and social condition of France. But it would be easy to give a series of similar considerations justifying the necessity for State Forests in India or any other country.

Communes when they owned forests, to a legal obligation to reserve one-fourth of their forests as timber forest for the benefit of the country. But in recent times the Communes have been treated as a mere embodiment of the local interest, and they have been consequently set free from this obligation. The "fourth in reserve" as understood under the Forest Code of 1827, is simply a measure of foresight and prudence, and even that, can, in many cases, be dispensed with.

If you were to ask, at the present day, a Commune in the Pyrenees to allow one-fourth of their forest to grow up into timber, and not to touch the trees for a century because the people on the north and west stand in need of timber of several centuries' growth, and they would laugh at you! Such abnegation of self-interest can hardly be looked for, when the popular mind is so toned as to be able, even for a moment, to raise local egotism to the rank of a social principle.

In France then the State alone remains capable of devoting its forests to the production of timber—a material which only the lapse of long years and prudent saving and abstention can produce.

And it is a most imperative duty and a national obligation resting on the Government, to perform its part in this matter.

Suppose, for a moment, that in consequence of a general sale, so often recommended and so often rejected by the public good sense, all the State forests were to pass into private hands.

In order to make it worth while for the new owners to preserve for future use, the wealth accumulated by the long and expensive mode of constituting capital under which the forest has been created, it would be necessary that the price of timber should be raised to a figure which would be portentous.

It has been calculated that in order to make the normal outturn of timber yield a reasonable rate of interest to a private proprietor, the price of a cubic metre of wood ought to be about 300 francs (between 30 and 40 rupees a cubic foot!) And even then the rate of interest would not be very high, since the calculation of capital value has to be increased in proportion as the selling price of wood rises.

Such a state of things would be impossible: foreign timber would undersell the local product in its own markets; and private proprietors would give up a task so irreconcileable with their interests. The forests of France would then all become coppice, and would, as the experience of the past proves, furnish nothing but firewood, or small wood for industries and petty manufactures. If it were attempted by law to compel people to conserve their timber forests, and yet not to charge more than a fixed maximum price, that would in fact be to put a special tax on them, since they would be obliged to sell relatively cheap what cost them dear; or else it would be necessary to keep all foreign timber out of the market, demanding all sorts of protection duties and measures of repression, which are opposed to modern ideas of trade and progress.

It is idle to oppose the necessity for State timber forests by referring to imaginary virgin forests in foreign lands, to which it is only necessary for our national capital and labour to flow, in order to bring in a rich return.

No one can assign a definite locality in which these mines of forest wealth are to be found, and the cry of alarm over the scarcity of timber has begun to be heard in America, as it has long been in the Old World.

But even if we suppose that some country still existed so fortunate as to have a good stock of well conserved timber, and be able to meet our demand for railway sleepers, ship-building, vine props, buildings of all kinds, and the thousand and one requirements of our voracious civilization, is it not likely that the State possessing the monopoly of indispensable produce might be tempted to make us pay too highly for it? Could it not, by levying a prohibitive export duty, impose on France the most disastrous taxes? wage against her that most terrible of wars—the war against industry?

See then to what a pass the loss of the State forests would bring us! If no restraint were put on the timber trade, still our industry and our power of construction would be at the mercy of foreign supplies. With full liberty to import, but with a compulsory price on indigenous timber, our forest owners would have to bear an unjust and unequal tax, and if foreign timber were prohibited, our own would rise to a prohibitive price, and effect a tax both on labor and on the consumer, the effects of which it is impossible to estimate. The State then must possess forests, and must manage them as much as possible on the high forest system.

It is time to remember that the State forests are intended to produce timber far more than money.

The Revolution found France with 6¼ million acres of forest. In 84 years the area has been reduced to 2¼ million.

CHAPTER II.—*Of schemes of working in general.*

Definition.—Too much space perhaps has been devoted to the considerations stated in the last chapter, but it is very important to make it perfectly clear what a great interest the State has in maintaining forest estates with a properly constituted capital or stock.

It is the express object of the State Forest Administration to see that this capital is never trenched upon, while the legitimate produce is made available for use and consumption.

An "aménagement," or formulation of a working scheme, is an operation which aims at facilitating the effecting of this important object.

The necessity for such an operation will at once appear, when it is remembered, that at the outset, in a mass of forest, it is not easy to distinguish the product from the capital stock. Both consist of wood; and the annual yield is really only a part of the capital set free for use by the growth of each year.

An "aménagement" is an operation which has for its object—

(1.) *To determine of what the capital stock should consist, or how it should be constituted so as best to meet the wants and promote the interests of the proprietor; and*

(2.) *To regulate the nature, the amount, and the relative order and progressive execution of the cuttings of the material, which, leaving the capital stock intact, constitutes the annual production.*

This brief definition requires some explanation to make it fully intelligible. Before giving this it will be necessary to put the reader in possession of certain details.

Ancient methods.—The arrangement of a working scheme is an operation as distinct from forest cultivation, as, in an industrial concern, the conduct of the business is from the manufacturing process; or, as in an agricultural enterprise, the distribution of crops on the area, and the constitution of the farm, is from agricultural labour.

The great difference is, that in industrial enterprises it is impossible to confound the produce with the capital; in agriculture it is sometimes possible; and in forest work it is very easy indeed to do so.

The question which a forest proprietor has to ask himself reduces itself to a problem which is very easily stated. Is your forest to be worked at, say, 120 years of age? Then the portion which you can cut in each year is the annual production, that is to say, the increment of the standing growth (which consists of trees in a scale of ages from 1 year to 120 years.) If one could determine exactly what this annual increment came to in cubic feet, the problem would be solved. By cutting this exact quantity, and no more, the capital would certainly be maintained intact.

But we are not yet perfectly acquainted with the laws of vegetation, and the studies that have been made in this intricate subject have not given results of such certainty as to form a perfect basis for practical work.

The earlier methods of *aménagement*, devised by Hartig and by deSalomon were based on the direct solution of the problem. They determined by calculating the rate of growth, the volume which each of the different parts of the forest could furnish, up to the moment for cutting. The total volume during the rotation of 120 years was added together, and the $\frac{1}{120}$th part of this total volume would form the annual production which might be taken out from those parts of the forest which cultural considerations indicated.

These more or less complicated methods, based on laws of increment more or less hypothetical, did not afford results which were satisfactory. The question was then shelved; and as the precise yearly increment of the capital stock, that is to say the volume to be cut, could not be determined, they tried to determine the capital itself, or rather to fix a limit of cutting,

a calculated quantity such as might make it certain that the capital was not trenched upon.

It will appear presently that this combination limited itself, in the case of coppice, to a simple division of the area into as many cuttings as there were years in the rotation; and in the case of high forest, to large cuttings made to correspond for a certain number of years, with the estimated volume of wood on the ground actually mature for felling. It is to M.M. Lorentz and Parade that in France this simplified method is due, and it has been found satisfactory in its results, and not difficult of application. To M.M. Tassy and Nanquette is due the extension of the principle, and the development of its practical application.

Material or Capital of Exploitation.—Before entering into detail about the combinations which constitute the different methods of devising plans of working, it is necessary to impress upon the students' mind the manner in which the capital is constituted in forest estates.*

Does the proprietor of 300 acres of forest land wish to produce an equal and permanent annual yield of wood at an age of 120 years? To do so he ought to possess—

2½	acres stocked with trees of	..	1 year,
2½	acres	,, ..	2 years,
2½	acres	,, ..	3 years,

and so forth; so that if he cuts in the present year the 120th compartment of 2½ acres now 120 years old, next year he will cut the 119th, which now is 119 years old, but next year will be 120, and so on.

If then our proprietor has 300 acres, of which the growing stock is in a regular gradation of *age*, and in that *condition of growth* proper to each age, he will have a forest capable of a permanent and uniform annual yield—he will have in short a capital perfectly constituted.

Three elements then enter into the constitution of the forest capital—the condition of growth, the area or superficial content, and the age. It is necessary that the ages should be graduated from 1 to 120 years; that the trees of each age should occupy an equal area, or an area proportional to the difference which exists in the conditions of growth in the estate: in short that he should have a stock of each age having the consistency and the volume conformable to the laws of growth in the given circumstances. For it is necessary that every year the felling should extend over an area equivalent to the one hundred and twentieth part of the forest—over the part that is 120 years old, —and over the part of the entire mass which cannot be determind *a priori*, but which is the annual increment.

It is necessary to enter into some details regarding each of

* "Material of exploitation," or capital, are used as synonymous terms, and the student will understand that they do not convey any idea of a *money* capital. The young stock of a forest is the capital destined to produce the yearly outturn, and is only *analogous* to the money capital which produces an yearly income.

these three elements, in order thoroughly to understand the economic conditions of forest management. We shall simplify the details by assuming that the general conditions of growth are uniform throughout the locality in which the forest is situated. We are thus free from the necessity of proportioning the three elements among themselves.*

With regard to *area*, it is easy to understand that on an estate of which the soil, the climate, and the situation are practically uniform, equal areas will produce equal quantities of wood. A proprietor who in our example should cut one of the compartments of 2½ acres every year, beginning with the oldest, and taking care that it is re-stocked directly it is cut, will have his capital constituted in the best and simplest manner.

It is obvious, therefore, that a considerable area of land is necessary to arrange the proper working of a forest. We must be able to cultivate and rear properly the trees of each class, according to their cultural requirements at each successive period of their life. The wood-producer, who has to work in earnest, and on a large scale, must possess an estate of sufficient size to give a proper allowance of speed to each age-class.

The proprietor of a clump of trees only cannot work it in the sense of *forest*-working. There is indeed a special method of working forests of small extent, the method of "jardinage," or selection-cutting; but even then the order of cutting is based on the supposition that there is a certain capital constituted by trees of every age, occupying respectively their proper proportion of the whole area.

The second element in the constitution of the forest capital is the *age* of the trees. It is an uninterrupted succession of ages from 1 year to 120 years which alone can enable us to keep up an annual outturn of wood 120 years old.

The circumstances of human labor, and the requirements of life, are, on the average, the same every year. The working scheme must, therefore, aim at producing the same amount of material every year. When we say the same amount of material, we mean approximately according to the nature of the produce. The gradation of ages may be considered to be practically attained when it exists within a limit of difference of five or ten years, or possibly more under particular circumstances.

In small forest properties, the working plan may aim at an annual or a biennial outturn, and dispense with the obligation of an *annual* income, which is the general rule in the case of large proprietors like the State or a Commune.

The third element is the condition of growth, or state of vegetation. The vegetation of trees growing together on a given

* A certain number of combinations have been devised in order to proportion the elements of the forest capital, the area, to the degree of fertility, the time, to the volume of wood produced. These methods are but little used, and the establishment of 'working circles,' of which we shall speak presently, furnishes a very simple means, and in general is quite sufficient to obviate inconvenience from inequalities in the local conditions of growth.

plot of land produces a stock (*peuplement*), the value of which varies with each year according to natural laws, the existence of which is certain.

Unfortunately what these laws are, is very little known from a practical or experimental point of view; and we know little more than the fact that there *are* such laws.

In order that the stock of each age-class should be properly constituted with regard to the entire forest capital, it is necessary that it should have the *density* and the *volume*, or cubic content, which nature assigns to each age under the given conditions of its existence. The *density* has reference to the number of stems on the acre, the *volume* to the number of cubic feet of wood on the acre.

The number of stems per acre of course decreases with the age of the trees; the volume follows an ascending scale, and is on the increase. This we know, although we are not able as yet to formulate numerically the law of this increase.

The number of stems on the acre begins by being very large in the first years of the growth of the stock. A certain number of them are suppressed by the more vigorous, and die out; and the number of stems goes on diminishing as the bulk of the stems goes on increasing.

On this fact depends the practice of thinnings* which will be explained in the chapter on high-forest management.

One can easily imagine how valuable would be a knowledge of the actual law of vegetation; the true number of stems per acre for each kind of tree and for each given condition of soil and climate. As it is, our only guide for regulating the number by thinning is the practical experience and the trained eye of the forester. The diagram (Fig. 1) will give an idea of the law of decrease in the numbers of stems.

The lower line is divided into equal parts corresponding each to a period of 10 years; on this have been drawn perpendiculars representing at the rate of 100 stems to the twentieth of an inch, the number of stems in an acre.†

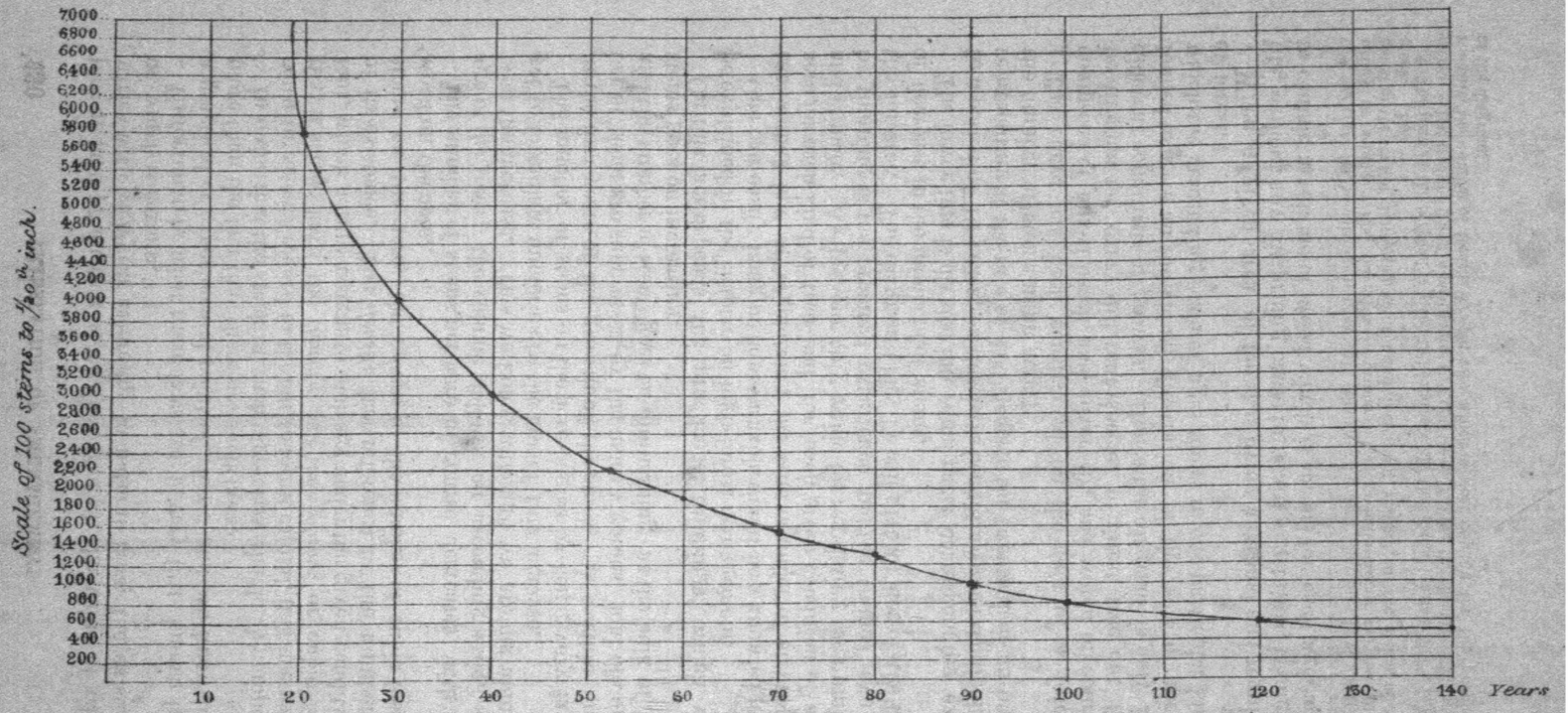
The curve has been constructed on the *data* of a forest composed of mixed beech and silver fir, and would of course be different for every different species of forest tree cut for different conditions of growth. Hence the diagram is only intended to give an individual illustration of the sort of curve which the descending scale of ages shows in one particular kind of forest.

When a given area of forest is living a normal and regular life, without any disturbing cause to retard vegetation, it ought to contain a volume of wood which is special for each age, and

* "*Eclaircies*,"—cuttings not for yield (though of course they may have a certain utility or selling value), but with the primary object of maintaining the law indicated in the text of decreasing number and increasing volume in the stems of the stock. (Tr.)

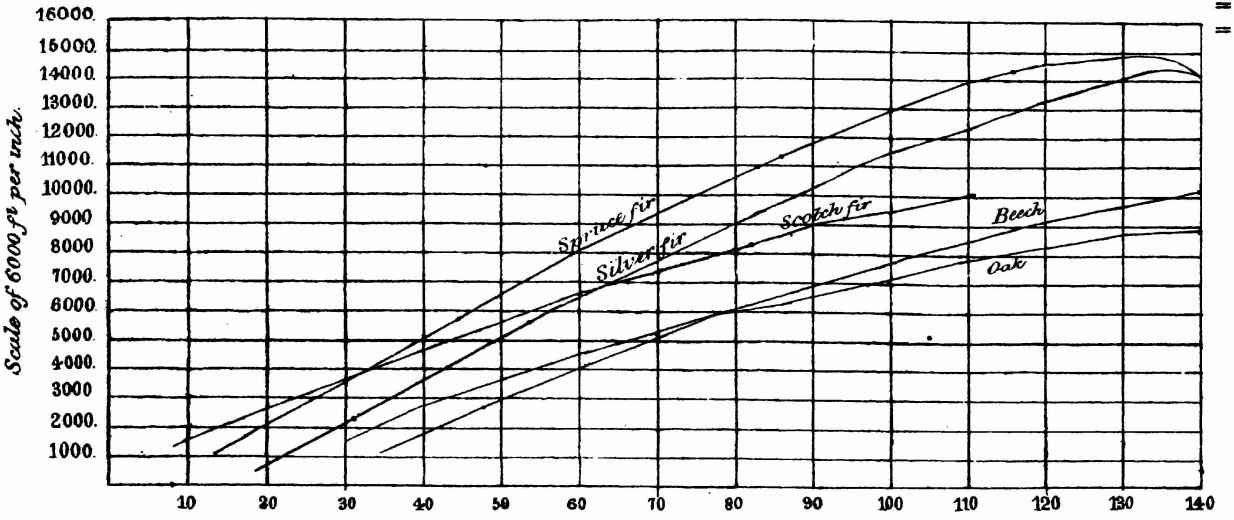
† The plan in the original is given in hectares with the actual scale 0·5 of a *millimetre* = 100 trees or 0·5 of a centimetre to 1,000 trees. Taking the hectare = 2½ acres roughly, the number of trees is 400 per acre, which is near enough for the purposes of the diagram.

Fig 1.



Curve shewing the decrease in number of stems per acre.

Fig 2.



Curve shewing the amount of material per acre for different species at different ages.

SPRUCE.

Mc. Heet.
1,000 per 1 at 140 Yrs.
= 35,317 cft. 2·47 A. „ „ „
= 14,300 „ per 1 A. „ „ „
etc., etc.

So that we have

cft.
14,300 per A. at 140 Yrs.
„ „ „ „ 115 „
11,440 „ „ „ 86 „
8,500 „ „ „ 63 „
5,720 „ „ „ 44 „
2,860 „ „ „ 23 „

And so for the rest.

for each kind of tree, and which is different according to climate and situation. This scale of *volumes corresponding to age* constitutes a second law of growth—a law still unknown, the results of it being only known by numerous experiments made on different kinds of trees in different places. The figure 2 annexed represents an endeavour to construct a curve for five chief kinds of trees on data furnished by tables published in Germany. The lower line gives, as before, ages in periods of ten years; and the perpendiculars show a scale of cubic contents calculated at one-sixth of an inch for 1,000 cubic feet. The resulting curves show the volume per acre for each age-class, but the reader must remember that this is only by way of general illustration, because exact experiments have not yet been made in sufficient number, or under such conclusive conditions as to enable us to lay done positively an absolute curve of increase for any species.

The recognition, however, of the general truth explained by these curves is very useful, not only in regulating the constitution of the forest capital itself, but also in settling important questions of forest economy, such for example as fixing the age at which to fell in order to have the largest quantity of material in comparison with the capital engaged; or determining the value of the capital, etc.

It is sufficient for general purposes roughly to classify the stages, and to describe the state of growth in a compartment by special means: thus we have *seedlings* (jeune semis), *thicket* (fourrés), *saplings* (gaulis), *poles* (perchis), *grown-poles* (haut-perchis), *young timber* (jeune futaie), and *old timber* (futaie). These terms are used in high-forests.

For coppice we use the terms *shoots* (recrus), *young stems* (jeune taillis), *medium-stems* (taillis), and *old stems* (vieux taillis).

These terms are only a convenient means of indicating the general style of growth, and tell us nothing about the volume of the stems, or the number of stems per acre.

The latter condition is roughly indicated in woods (without indicating the quantity) by the addition of the adjectives* *sparse* (clair), *fairly-stocked* (serré), and *fully-stocked* (complet, &c.)

Under all circumstances, however, the state of the stock as regards its growth depends always on one principal element—its age: therefore, when we say that the capital of a forest to be cut at 120 years must consist of a graduated scale of ages from 1 to 120 years, we mean by this formula to express the necessity for a series of compartments, each stocked with the proper age class respectively. This will readily be understood; but it is as well to bring distinctly to notice the real meaning and extent of the formula.

Explanations.—We are now in a position to return to the

* See Baguenis' Manuel de Sylviculture, p 5.

general definition of an "aménagement" with which we started at the commencement of this chapter, and to study its terms more minutely.

1stly.—When I said that the first object of formulating a working-scheme was to "*determine exactly* of what the *capital stock should consist*," I had no intention of indicating that it had to be estimated either in quantity or in money. That would be useless. The capital must be, during the whole time of working, invariable and constant; that is to say, it must always show the same proportion of the different ages, the same area under each, and the same state of the stock on the area.

Valuation will of course be made of the area and of the volume of wood on it in different parts, in order to regulate the quantity to be removed by felling: but to determine the capital itself, it will be sufficient to have it within defined limits, and then to manage it in such a way that the cuttings will never reduce it.

The combinations involved in a working scheme will be so devised as to allow the annual growth of the wood continually to replace the amount taken out.

2ndly.—In undertaking to work a forest, just as in undertaking to work a farm, there must be a definite aim or object in view.

Our object may be to turn out a particular class of produce for the market, say vine-props, hop-poles, planks, wood for carpentry, or perhaps only wood for charcoal, or the proprietor may be indifferent as to the kind or form of produce, as long as it brings him in the largest possible return in money. It may be, that looking to the interests of the consumer alone, his object is to get the greatest outturn of wood of all sorts, or to get that form of timber which is most in demand for commerce.

These different objects afford as many different bases for fixing the age of "exploitability."*

They indicate as many different ages at which the yearly cutting of a forest may be fixed.

I shall not enter into the details of the manner in which the age of cutting is determined according to any particular object in view; that would necessitate my travelling beyond the scope and purpose of this book; but it is easy to understand that all enquiries as to the age of exploitability will always end in fixing the age to which the *rotation* of the forest is adapted †

* This term indicates the age at which the trees may be cut in order to satisfy a given purpose of the Proprietor (*Author*)

An oak coppice may be "exploitable" at the age when the bark is most in quantity, or richest in tannin; if the object of working is the bark trade, or it may be the age at which the soundest timber in the largest quantity is given; if the object is timber for ship building (Tr)

† Rotation (*revolution*) is the period in which the working (yearly-cutting) has gone over the entire extent of the forest and comes back again to the point at which it began. There may be a rotation fixed for a period which does not correspond to the age at which it is intended to cut (as the age of maturity for the purpose in view). But such a rotation is only a "transitory" or "preparatory" rotation,

Now the importance and the value of the forest capital will always depend on the age at which the trees are to be considered mature and felled.

If the felling age is 30 years, the capital will consist of compartments stocked with ages from 1 to 30 years. If the rotation is only twenty years, it will be made up of ages from 1 to 20 years.

The words "to determine the constitution of the capital" in our definition, necessarily include the enquiries as to the age of exploitability to be adopted, and the fixing of the most advantageous length of the rotation. This is, indeed, the first thing to be done in determining the requisite constitution of the capital.*

3rdly.—It will also be apparent that the definition should include a preliminary matter to be settled before seeking to determine the constitution of the capital: namely, the question, what sort of system the forest is to be worked on? Is it for high forests or for coppice? And in either case, what sort of high forest, whether to work on the natural method, or by selection; and what sort of coppice, whether "simple" or "stored," *i.e.*, with reserved standard trees left to grow to timber size?

It will be observed that, to a great extent, the system of reproduction and the treatment are determined for the proprietor by the nature of the trees of which his forest consists, and by the circumstances in which he is placed.

When it is possible to make a choice among a number of different rotations, the proprietor must choose, and he will then have a capital of exploitation corresponding to the one selected. It is so at any rate in the majority of cases; because one cannot change in a day the treatment of a forest as one can the *regime* of a workshop.

The long process of forest transformation, which we shall study in our chapter on "Conversions," can only be undertaken by proprietors exceptionally situated, such as the State and the Commune. Even in these cases, the determination of the style of management is rather a choice to be made than an operation to be effected. The general term "determine the capital of exploitation" comprehends all the different cases, since the various systems and methods of treatment are each characterized distinctively by the peculiar capital proper to each—a capital on a large scale for high forest and much smaller for coppice.

The operation of laying down a "working-plan," *i.e.*, of determining the capital of exploitation, carries with it the choice of the method of treatment as it carries with it the choice of a length of rotation.

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and is applied when certain operations are required progressively over the forest during a period of preparation, before the regular rotation can begin.

* See M. Nanquette's "Cours d'Aménagment, Ch. IV, for the procedure which are necessary to determine the age at which forests are exploitable.

4*thly*.—The choice of the age of exploitability is intimately connected with the class of proprietor who works the forest. A private person does not care what the nature of the consumption of the public is, except so far as it produces a favourable market for his produce. A Commune, and still more so the State, represent far more the interest of the classes who consume wood. The phrase in the definition which alludes to the advantage or *requirements of the proprietor*, is intended to include every possible case.

5*thly*.—The definition also states two objects as aimed at by the process of laying down a working-plan—the determination of the capital of exploitation and the regulation of the cuttings which indicate the amount of the annual production. We shall always find this double object realized in practice by the preparation of a general plan of working, and of a special detail as to the order of the cuttings. The one tends to conform the forest to a style of growth and condition which fits it for a certain purpose. This purpose is as fixed and unalterable as it is in the nature of human affairs to be; the other regulates in a special manner the cuttings to be made during a short period of years. Here, this point is only indicated, as it can better be more fully explained at a later stage.

6*thly*.—The regulation of the working-plan is, in reality, only the application of certain cultural rules to produce a given desired result.

Without following such laws, there can be no good scheme of working, any more than the best distribution of lands in a farm between different crops and the best arranged farm buildings, will produce a satisfactory return, without reference to agricultural rules prescribed by the nature of the soil and the kind of crops cultivated.

The definition then indicates the natural alliance between the rules of sylviculture and the progress of the exploitation, when it directs the *aménagiste* to regulate the "nature, relative order, and progressive execution of the cuttings." It thus binds him down to the strict observation of cultural principles, of the rules for locating cuttings, and of the laws of vegetable physiology.

The reader will, I am sure, pardon this lengthy paraphrase of the definition: but it is necessary to make it as explicit as possible.

In a book in which only a few pages can be devoted to the theory of the subject, the elementary notions which are necessary to render intelligible what follows of practical information, can only find a place when grouped around the preliminary definitions with which the study of the subject commences.*

*It may be permitted us to remark that the definition adopted in the text thus is made to fall in with the otherwise much more concise definition in the "*Cours d'amenagement* which runs as follows "[Aménagement is] an operation

Utility of an Amenagement.—Certain forest proprietors have contended that for private forests the advantage of a regular working scheme is illusory, because such a scheme is likely to be upset by the inevitable process of division of private estates. [This alludes to the French law of succession and division of estates among the heirs—Tr.] The objectors have in this case confused the usefulness in the abstract of an amenagement, with the question of whether the scheme is likely to be observed for long. No human undertaking can free itself from the chances of the future or from accidents which may occur in its progress. And the proprietor who provides a working-plan for his forest is just as much subject to this law, as one who starts a manufactory or a trading company.

It is also possible that even the working-plan of a State or Communal forest may be upset by circumstances.

But the utility of such a scheme in itself is quite another matter. It is because of the facility that it gives for the execution of forest operations advantageously and without loss of time, and because of the regularity and method which it introduces into the working, that the laying down of a working-plan impresses the forest with the character of a well managed estate, and consequently increases its value; just as in agriculture a well regulated, and well arranged farm, will always have for an equal area, a greater value, than an estate badly directed, and ill cared for.

Are there not also many circumstances under which a regular plan must be followed, or may be required by law? The various forms on which a mere *usufruct* is allowed by the law, all require it, because such a usufruct legally requires that the "substance of the estate should be intact."*

It is obvious that if the products only have been taken on a regular plan of working, it is easy to establish by proof that the legal conditions of enjoyment have been fulfilled, and thus much ruinous litigation may be avoided. In the case of a liquidation, or rendering an account on termination of a usufruct, if the estate has been managed on a regular plan, it will avoid much difficulty, and many disputes, to be able to show what was capital and what was produce, and that the former has been left intact. Had this not been ignored, how many powerful families would have still remained united.

Condition of the forest.—We have already seen that a forest fit for working must show a certain gradation of ages, and a certain uniform state of growth. A theoretically correct

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which for one or several rotations regulates the mode of cultivating and of working a forest to the best advantage for its proprietor, and for the consumer." In a work dealing with the management of public forests, there was no occasion to speak of the capital of exploitation, because there can be no good administration or no efficient management, without the existence of a capital account, and consequently of the capital which is accounted for.

* Code Civil, Section 578, *et seq.*

*condition of forest in this respect is called a "normal forest."**

A perfectly normal forest rarely or never exists in nature, but such a condition must be kept in mind, not as an object to be attained (which is probably impossible), but as a basis or standard of comparison for every combination which enters into the working scheme.

The capital of exploitation or standing crop is constituted when the three elements—area occupied by the different growths, age, and a certain state of vegetation or rate of growth—exist all of them together in a manner sufficient for working the forest at all. It is then possible to find a forest in which the capital is constituted as far as the gradation of ages is concerned, but which does not contain a sufficient area occupied by each, or a sufficient volume of each. There may be also different cases in respect of rate of growth,—the differences being almost infinite when the vast variety of climate, &c., is considered. But practically all cases are reduced to the three following which will be the basis of our study :—

(1). *The standing crop is just large enough for the chosen rotation.*

(2). *Or it is excessive.*

(3). *Or it is insufficient.*

The first case we call "regular," because it approximates to the theoretical condition of a normal forest already described, as far as circumstances allow. The second is unfortunately rare. The demands on the forest are too incessant to make it likely often to occur. But it may occur when the proprietor wishes to shorten the term hitherto contemplated for the maturity of his forest. The third is the commonest, and is one which requires the skill and care of the forester.

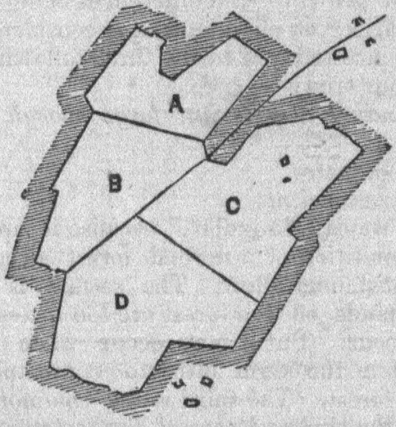
The reader will remember that in actual practice we have always to deal with forests more or less irregular.

Formation of compartments (*Parcellaire*).—The first difficulty is, to obtain a practical knowledge of the manner in which the forest for which we wish to lay down a working-plan is constituted :—We have to find out what it really contains. It will be readily understood that in a forest of any size it is not possible to obtain at first sight, and by a general inspection of the whole, a clear and sufficiently exact idea of its resources. We have then to begin with an analysis and an inventory of its contents. But here we are not dealing with an inventory of the number of trees or of the total number of cubic feet. It is something much more simple than that. We have to go over the whole ground, surveying the different divisions indicated by lines, and thus marking out all the different *local areas which consist of groups homogeneous in age,*

* The normal forest is one that presents a gradual succession of ages, and a growing stock of each age, growing under equal circumstances, as regards area occupied by each, soil, climate and exposure, such as will result from a regular process of growth during the entire rotation.

in kind of tree, and in conditions of growth, and which are accordingly susceptible of the same treatment. These local areas or bits of forest are called *compartments*, and impress themselves readily on the memory, so that having divided the whole area in this way we are able to seize the entire aspect of the forest and grasp its resources as a whole. It is necessary also to separate the portions which, from their different aspect, or different species of tree, will require, pretty permanently, a special method for the cultivation of the growth on them. We shall thus discover by the combined work of memory and inspection, if the forest capital is constituted, that is to say if the forest already presents a sufficient capital to permit of a regular exploitation based on the term of years adopted for the rotation.

Forest of Ancourt.



Each compartment is carefully described in a register to which reference can always be made.

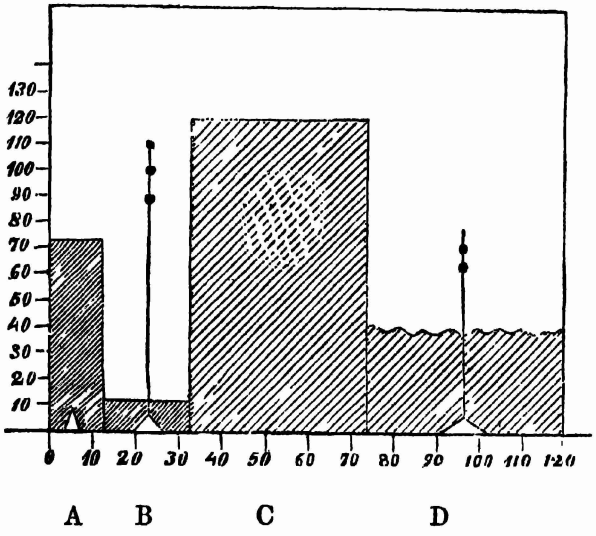
When, however, the forest is large, and the number of compartments considerable, the mind begins to get confused, and it is desirable to clear up matters by some supplementary proceedings. Of these some consist in preparing a synopsis or table of the compartments, in which the prominent elements, age, species, state of growth, &c., are exhibited. In this way the compartments are presented, so to speak, in a condensed form.

Others consist in aiding the mind by graphic representations or diagrams, the modes of preparing which are various; but the following will serve as an example:—

A horizontal line is drawn, divided into equal parts, each representing so many acres. On this base line rectangles are drawn. The base of each represents the area, and the height, the age of the growing stock. The top line of the rectangle is straight, or wavy; if the latter, it means that the stock is irregular; if the former, that it is regular. The rectangles are

shaded with lines closer or further apart, which indicates that the stock is more or less close or sparse. A sign, in the shape $\wedge$, is used to denote the rate of growth. If rapid, the angle is made more acute; if slow, more obtuse. If there are large trees in the compartment, a vertical line is drawn, and two or three dots in this line show whether such trees are numerous or the reverse. It is customary to indicate differences of soil, and the prevalence of different species on the map, by aid of conventional colors.

This will be understood from the following figure:—



This figure shows at a glance, by the diagram method, the following state of compartments:—

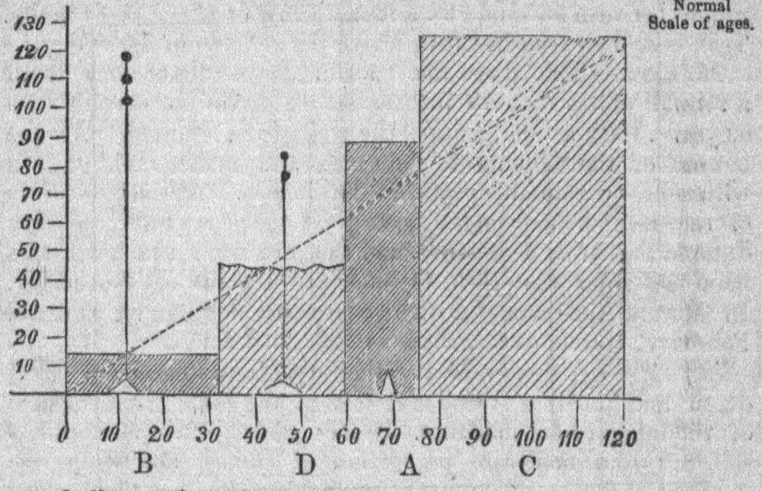
Rectangle A—Consists of 14 acres of grown poles passing into the state of young timber of 75 to 80 years old, very active growth; stock dense and regular.

„ *B*—Consists of 24 acres saplings and thicket, regular, healthy; rate of growth, medium (neither very active nor slow); complete stock surmounted by a good many large trees. Mean age; 10 years for the general stock; 90 to 110 years for the large trees.

„ *C*—41 acres high forest, exploitable at 120 to 130 years; stock very open, and even containing some open glades; growth, stationary; on the whole the stock is even (or regular).

Rectangle D—41 acres poles of 40 years, on the average mixed with stems younger or older, and with some trees of 70 to 75 years old. The stock is thus irregular and open; vegetation rather slow.

If we now rule lines, the base divided as before to show area and draw vertical lines also, showing ages, and a line across showing the ascending scale of ages, and then cut out little pieces of paper of the size of each rectangle, and arrange them on the scale so that the youngest may come first,—



we shall see that the material or capital is tolerably well constituted.

Comparing now this scale with the map of the forest, and seeing in what parts each area lies, we shall see if it is regularly disposed in such a way that a convenient order of compartment cuttings can be adopted in such a manner as to suit the rules of cultivation.

Such is the mechanism of the proceedings adopted. There are theories and practical rules regarding the formation of compartments which it is not the object of this little book to explain, as it does not aim at teaching how to make a working scheme, but in what such a proceeding consists.

I need only remark that in order to make a satisfactory "parcellaire" or division of the forest into compartments, aptitude and experience are as much necessary for the forester as they are for the farmer who studies the different varieties of soil in his farm so as to distribute advantageously the crops he will cultivate on its different parts.

Teak.

I.—Geographical Distribution.—In Coorg teak grows in a zone of from two to six miles in breadth along the eastern boundary, at a rough calculation 40 square miles, mixed with other deciduous trees, such as *Terminalia tomentosa*, *Pterocarpus marsupium*, *Dalbergia latifolia*, and *Anogeissus latifolia*.

It is also found occasionally in clumps at the bottom of the Western Ghauts.

II.—Requirements as to :—

(*a.*) *Climate.*—The temperature of the deciduous forest ranges between 56° and 96°, seldom below or above these limits. Teak is seldom seen in Coorg above the altitude of 3,000 feet.

Moisture.—Teak does not attain large dimensions with a rainfall of less than 45 inches, but we have no certain data as yet. With a small rainfall the tree grows stunted. At the bottom of the Ghauts it flourishes and makes rapid growth with a heavy rainfall, probably 200 inches. About two-thirds of the rainfall is from the south-west monsoon from the 15th June to the 15th September, and the rest from the north-east monsoon from the 15th October till the end of November. In March, April and May there are occasional thunder showers. February, March, and April are usually hot and dry.

(*b.*) The *soil* should be a rather stiff loam, must be of good depth and fairly well drained, but at the same time capable of retaining some moisture. It does not object to ferruginous soil, nor to a moderate proportion of stones, and from the frequent presence of lumps of lime found in Coorg teak wood it may be inferred the soil is often calcareous, and not exactly congenial to teak. In the deciduous forests the upper layer of soil, varying from 9 to 18 inches in depth, is a black vegetable soil. This layer of soil is extremely rich. It is friable and easily worked. Beneath is generally a stiffish loam several yards deep, light brown and sometimes yellow in colour. The underlying rock, which is very rarely seen in these forests, is generally gneiss.

(*c.*) *Locality.*—As already stated teak is not found often above an altitude of 3,000 feet ; the deciduous forests of Coorg and of Mysore are from 2,500 to 3,000 feet above sea level. It grows equally well in all aspects. It prefers a gentle gradient, such as will carry off the water, but does not like steep land. Thus it grows best in undulating country with low rounded hillocks.

Below the Ghauts it is found on well-drained rounded knolls and spurs.

III.—Dimensions.—The average height and girth attained in Coorg is 8 and 80 feet respectively, but the girth measurement in the south-eastern forest, in which grow the finest teak, is often much exceeded. A few trees there measure as much as 15 feet in girth. They are old trees which we have

at present no means of turning to profit owing to their great size. The maximum height is about 120 feet. Below the Ghauts it does not grow to a great height, but is generally stunted owing to its exposed position, but the boles attain a large size.

IV.—HABIT.—The ramification is diffuse, the branches nearly at right angles to the stem. The foliage is light letting through light and sunshine. The crown is egg-shaped in a solitary tree, occupying about three-fourths of the tree's height. In the forest it occupies from half to two-thirds of the tree's height. The length of the bole of a tree in the open is about 15 feet; in the forest about 30 feet.

V.—TEAK CANNOT THRIVE UNDER COVER.—It will exist but will make no growth; it gets bent and lanky; but with its leading shoot free it will grow and flourish. Teak rarely pierces through cover unless it is very light. Even under teak cover, itself very light, young teak does not thrive. In some portions of the Coorg forests, which were very badly treated before the establishment of the Forest Department, and in which teak was cut out recklessly, neither teak seedling nor coppice have been able to grow owing to the bamboo cover. But young plants will exist for years under cover, hardly making any growth, and will recover when disembarrassed.

It objects to interlace its branches, and its head becomes contracted by contact with other trees.

VI.—PERSISTENCE OF LEAVES.—The leaves fall in February and begin to reappear soon after the jungle fires, and the trees get their full foliage by the middle of June.

VII. TEAK BECOMES FERTILE AT BETWEEN 20 TO 30 YEARS in plantations, often much sooner. But seed should be chosen from trees 50 to 60 years old. It flowers in June and July, and the seed ripens in March. The seeding is annual, but in favourable years it is much more prolific than in others. An early monsoon, such as that of 1879, which commenced in Coorg with a heavy burst on the 28th May, destroys a great part of the blossom. A very light monsoon, like that of 1877, is also unfavourable to the seeding. The seed has considerable vitality, and could probably be kept several years without losing it. Seed sown in the ground, which has failed to germinate in the first year, will often do so in the second. It is frequently destroyed by insects, which bore into the outer covering when it is young and soft and eat the kernel.

VIII.—TEAK SEED IS NOT EASY OF GERMINATION.—For cultural purposes it is soaked for 48 hours in water before it is sown, in order to soften the hard shell in which the small kernel is contained. In nurseries, unless the seed has been very well chosen, a very small proportion of the seed put down germinates, because a large proportion is pierced by insects and loses its vitality. It is believed that this pierced seed has a tendency to fall from the tree sooner than the healthy seed,

and on this account we always try to get our nursery seed gathered from the tree itself, not collected under the tree.

In the forest young plants are not seen unless there is an entire absence of cover—not even under the light cover of old teak foliage. On the other hand in open spaces a number of seedlings will frequently be seen.

There is some reason to believe that jungle fires aid the germination of teak. It is very possible that the charring of the outer shell may help germination. Also the destruction of underwood will let in the necessary light and air without which the young plant would not persist. On the other hand the fires must destroy annually a large quantity of teak seeds.

IX.—TEAK SHOOTS EASILY FROM THE STOOL and will do so under favourable conditions up to a great age. Stools of trees 250 years old, and of even older trees, will sometimes coppice.

X.—AS REGARDS THE RAPIDITY OF GROWTH in the small plantations in Coorg plants grow to a height of 35 feet and 1 foot 6 inch in girth in 10 years. There would be presumably a similar growth under favourable conditions in the forest.

In the latter case, however, they are often dominated by short-lived soft-wood, such as *Kydia calycina* and *Grewia tiliæfolia*, and simply hold on to life, making very trifling growth until room is made for it by one of the dominant trees succumbing. In other cases the plant gets continually burnt down until a shoot of sufficient height and strength is produced to defy the fires. This then makes rapid growth, unless it gets covered up by soft-woods.

Ring counting on stools of trees in the forest give most variable results. We find trees, after growing very slowly for 150 years, will suddenly put out great vigour and add an inch of growth in eight years—the same individual at 50 years having only been able to make an inch in 20 years.

In the accompanying table No. 6 stump shews 28 rings to the second inch, shewing that it was long dominated in its youth.

Judging from the ring countings which have been made in the Nalkery forest, the best teak forest in Coorg, it must take 250 years to make a first-class sized tree 6 feet in girth at 5 feet from the ground. In a plantation, the same size would probably be attained at little more than half the age, or say 150 years. In the plantations in the hot steamy climate of Nilambur, this size will, judging from the growth, hitherto be attained at the age of 80 to 90 years.

It is burnt down when young by forest fires, often year after year, only to send up a stronger shoot each time, till at last it gets above the fire's reach. After this it is little affected by them, until they pass their maturity, when the fires gradually eat into them at the bottom, but so gradually that as a rule the tree at length succumbs to decay from the top. Insects sometimes attack the young branches of teak plants raising

wooded rings on them, making them look as if strung with big beads; two or three such are often seen on a branch. It is not apparently much injured thereby, but their presence probably denotes an unhealthy state of the tree. Young plants are sometimes bored in the stem by grubs; this is remedied by cutting down the bored stem, and is not sufficiently general to do much damage.

Deer and cattle do little damage to young teak in the forest. Cattle boys do more damage in mischief than their cattle.

In para. V it has already been stated that teak is very much averse to direct cover, even of the lightest. It grows lanky and crooked, but recovers itself when disengaged. With our other hard woods, if started at the same time and kept free of rapid growing soft woods, it can take care of itself fairly well. In mixed forests it often becomes dominated by the soft woods, as also by some of its companion hard woods, such as *Pterocarpus marsupium* and *Terminalia tomentosa*, which grow to a greater height. Its growth is much retarded thereby, but it is long suffering, and having lasted out its tormentors, makes a fresh start.

It is generally found in mixed forest with Terminalias, *Pterocarpus marsupium*, blackwood, &c., but often a clump of teak trees is found in the forest. Sometimes in high forest an area of two or three acres is seen full of teak, with here and there a tree of another kind.

A few instances of this sort are to be seen in the Nalkery forest in Coorg. In some parts of Mysore there are coppice forests of almost pure teak. Here the superior coppicing property of the teak, its ability to withstand fires, and the respect with which it is treated by the natives as a reserved tree, have left it in sole possession.

XI.—Results of experience hitherto gained regarding its artificial cultivation.—Attempts to raise teak in the forest by direct sowing have always been lamentable failures, and appear to lead to nothing but disappointment, loss of time and money.

Planting.—The best way to raise the plants is to make nurseries in February and put down the seed in the beginning of March, and water profusely.

The seed must be steeped in water for 48 hours before being put on the beds. It is necessary to put down a very large quantity, as only a small portion of it germinates. The beds should be carefully made with a diminutive wall all round them, three or four inches high, to keep in the moisture to a certain extent, otherwise the surface of the nursery would dry up again as soon as the watering was left off, the season of year being very hot and dry. The seeds, if well watered, germinate in three weeks, and by the breaking of the monsoon many plants are four inches high and ready to plant out.

The plants should then be put out in pits one foot deep at 6 or

6½ feet apart, which have been ready prepared. Planted at further distances than this the young plants take a long time to close up over the ground. 8×8 feet and 10×10 feet have both been tried in Coorg, the result being an enormous crop of weeds on the ground, which has to be continually fought against at great expense, in which the teak plants grow in a languishing way. At Nilambur 6½ feet × 6½ feet is said to be the best distance, so that in Coorg probably 6 feet × 6 feet would be the proper distance, as it is not such a forcing climate.

In planting out due care should be taken not to injure the roots, and the plants should in no case be handled by the naked hand more than is necessary. They should, when taken out of the nursery, be placed on a piece of bark and carried on it to the pit. The workman then thrusts his left hand into the middle of the pit, which has been previously filled with soil, and makes a wedge-shaped hole in the soil. He then takes a plant up with his right hand and transfers it to his left which he has kept upright in the pit, and keeping it in an erect position with the thumb of his left hand, he gently fills in the earth with his right and withdraws his left. He should then press the earth down gently round the plant.

The whole of the area to be treated should be planted in the first burst of the monsoon, and subsequently, after each break, it should be gone over again, and any vacancies should be filled up.

If this be done systematically, it should require no supplies thereafter, and it is always unsatisfactory to have to supply vacancies a second year.

Another great secret of success is to have a perfectly clean felling.

In most of the old plantations in Coorg jungle trees were left here and there, which are now a source of great annoyance, many of them have to be girdled to the heart wood before they will die.

Towards the end of the monsoon the weeds should be cut over, and the plants hoed round.

In subsequent years two weedings will be necessary, until the plants begin to close up at five or six years old.

After this it will not as a rule be necessary to do anything till the plantation is ten years old, when a thinning should be made; after which repeated thinnings are required at intervals of three or four years, the interval becoming longer as the plantation becomes older. Parsimony in weeding in the early years is a great mistake; the weeds should never be allowed to get over the plants. If this is attended to, the plantation may be said to be established the fourth year.

In favourable localities, where labour is to be got with facility, the cost would probably not exceed Rs. 50 per acre for the six years, but in Coorg, labour being expensive, the cost is higher.

Statement showing the Enumeration of Annual Rings of Teak in Nalkery Forest.

No.	Girth.	Height to first branch.	No. of rings per inch from the centre 1st inch.	2nd ditto ditto.	3rd ditto ditto.	4th ditto ditto.	5th ditto ditto.	6th ditto ditto.	7th ditto ditto.	8th ditto ditto.	9th ditto ditto.	10th ditto ditto.	11th ditto ditto.	12th ditto ditto.	13th ditto ditto.	14th ditto ditto.	15th ditto ditto.	16th ditto ditto.	17th ditto ditto.	18th ditto ditto.	19th ditto ditto.	20th ditto ditto.	21st ditto ditto.	22nd ditto ditto.	23rd ditto ditto.	Age.	Cubic contents of logs obtained.
1	...	...	11	16	10	19	19	26	17	17	24	14	...	...	...	...	...	...	...	...	...	...	...	...	...	173	
2	...	...	8	14	9	9	28	4	6	16	17	24	28	11	...	...	...	...	...	...	...	...	...	...	...	174	
3	9 7	32	12	5	18	5	4	4	11	25	11	28	8	13	13	15	14	17	22	20	25	30	45	...	...	345	
4	10 3	40	6	7	7	4	2	2	3	3	4	4	5	5	7	9½	8	10	12	13	7	17	22	15	9	180	
5	7 0	36	3	4	5	5	5	3	3	7	9	12	15	28	44	23	...	...	...	...	...	...	...	...	...	166	
6	8 4	30	7	28	9	3	5	10	8	7	5	8	13	19	...	...	...	...	...	...	...	...	...	...	...	122	39 cubic feet
7	7 9	25	7	22	23	12	16	10	10	5	7	9	14	18	22	16	...	...	...	...	...	...	...	...	...	191	39 „
8	7 2	39	9	7	6	6	4	5	7	7	10	12	8	12½	16	25	...	...	...	...	...	...	...	...	...	133	
9	...	...	4	6	7	13	7	9	20	30	24	22	21	20	...	...	...	...	...	...	...	...	...	...	...	173	
10	8·0	21	7	6	12	21	11	8	16	14	14	12	11	8	10	12	8	17	16	...	...	...	...	...	...	203	
11	...	...	6	12	12	12	13	18	26	8	25	41	28	...	...	...	...	...	...	...	...	...	...	...	...	201	
12	9 7	32	9	6	5	13	4	10	19	11	4	6	19	23	25	28	...	...	...	...	...	...	...	...	...	182	
13	8·0	33	5	18	22	18	18	22	27	21	9	7	9	21	19	23	18	24	16	...	...	...	...	...	...	297	58 cubic feet
14	7 0	16	5	11	16	5	18	19	9	30	18	15	29	29	35	22	...	...	...	...	...	...	...	...	...	261	49 „
15	9·0	35	6	8	11	12	8	7	27	17	10	26	13	8	13	21	17	22	...	...	...	...	...	...	...	228	75 „
16	11 0	45	12	10	5	7	5	5	7	8	12	14	14	11	17	13	10	11	11	17	21	23	16	...	...	249	99 „

The Cape Forests.

Report of the Superintendent of Woods and Forests, M. le Compte Vasselot de Regne.

(*Continued from page* 153.)

III.

Condition of Well-known Countries from a Forester's point of view.

Remarks on management of the forests of various countries, with statistics of yield, exports and imports of timber in each country.

Having shown the part which forests play in the constitution of climates, we will now, in order to judge by comparison of the circumstances of the Colony in relation to its extent of timbered lands, cast a rapid glance over the extent of the forests in well-known countries.

Sweden.

Total area	51,530,000	morgen.
Forests	20,430,000	„

or more than 40 per cent. of the territory. The annual production is 1,050 millions of cubic feet.

The Crown forests have an area of 3,980,000 morgen.

Production is exceeded by consumption, exportation included; and the result is the gradual destruction of the forests. The Government, however, devotes annually a sum of £12,000 to the acquisition of forests in order to enlarge the State domain, and thus endeavours to secure conservation of a timbered area sufficient for the country.

Norway.

Total area	36,784,000	morgen.

The wooded area comprises between 7 and 12 millions of morgen.

British Isles.

Total area..	76,000,000	acres.
Forests	1,500,000	„

Timber for constructive purposes is produced in the Crown forests and in private domains, and is found, to a large extent, in quickset hedges, parks, and isolated plantations.

Dr. Becker estimates that a property which does not possess trees, with trunks of various ages, equal in value to twice the rent of the estate, is not sufficiently stocked with timber.

Besides the timber which she receives from her Colonies, England imports annually from Sweden 5,600,000 cubic feet of sawn wood, and also considerable quantities from Germany, Austria, and Russia.

British India.

The total area exceeds 400,000,000 morgen.

Forest staff recruited by selected British subjects trained at Nancy.

Besides the timber absorbed by local establishments, the forests reserved by the Government occupy an area of rather more than 50 millions of morgen. These forests are managed by an administration recruited by means of young men selected by the Queen for studying the art of forestry at the French School at Nancy. These British subjects are not, however, provided with appointments until they have shown themselves capable of filling them satisfactorily.

Cyprus.

Total approximate area	..	1,200,000 morgen.
Woods and forests	..	200,000 „

Soon after taking possession of the island, the British Government applied for a French expert to organise the forest service there. This officer is now at work,

Dominion of Canada.

Total area	... ...	170,500,000 morgen.
Forests	... ...	93,200,000 „

The rapidity with which disafforesting has taken place in the country has already caused the gravest apprehensions in certain parts of this continent.

New Zealand.

Total area	... ...	31,700,000 morgen.
Forests	... ..	5,660,000 „

Mauritius.

Mauritius, now being replanted.

In this island they are replanting with the conviction and zeal taught by experience acquired at great cost.

Denmark.

Total area	... ...	4,400,000 morgen.
Timbered area	... ...	232,000 „

The area managed by the Government is of about 45,000 morgen. It comprises cultivatable lands conceded to forest agents, whose emoluments take the form of a percentage on the profits of the productions of the forests. It also includes lakes and roads.

Forest agents paid by a percentage on profits.

From 1871 to 1875 the excess of importations over exportations had risen to 11,200,000 cubic feet.

Since 1805 Denmark has bestowed serious attention on replanting, and since 1864 the Government has pressed forward this work with redoubled and patriotic energy.*

* Dr. Muller, Professor at the Academy of Agriculture and Forestry, Copenhagen.

Russia.

Total area ...	...	562,795,000 morgen.
Timbered area ...	...	224,000,000 „

of which 147,600,000 morgen belong to the State.

The forests, although covering more than 40 per cent. of the total surface of the Empire, are very unequally distributed. They preponderate in the northern provinces, where they form an unbroken belt between the polar regions and the 59th degree of latitude, but are very scanty in the southern provinces, without the possibility of establishing the requisite equilibrium. Moreover, while exporting a great quantity of timber (valued in 1871 at £2,247,153), the Government has been none the less compelled, by sheer necessity, to carry out works of replanting in the southern provinces.

France.

Total area ...	...	61,395,000 morgen.
Timbered area ...	...	9,300,000 „

of which 3,488,000 morgen are subject to forestry regulations.

There are also eight millions of morgen in furze, heath, and common brushwood, which do not exercise anything like the same influence as trees do, and are considered as waste lands from which no revenue can be derived.

The timber imported in 1878, the last year for which I have particulars, represented a capital sum of 220,600,000 francs (say £8,824,000), exceeding by £7,500,000 the value of the exportations.

France is generally considered as insufficiently stocked with timber.

On the central plateau, in the Cevennes and on the Pyrennees and Alps, large extents of forests exist. However, the English writers, Forbes, Tyndall, and Whymper, give a melancholy description of our mountains. But the Government is pursuing energetically, and with complete success, the re-wooding of the denuded parts. The works undertaken in execution of the law of 1860, extend over more than 80,000 morgen, and it is roughly estimated that they ought to embrace an area of more than 800,000 morgen, or ten times the area originally estimated for.

Algeria.

Superficial area ...	...	72,000,000 morgen.
Forests (about) ...	...	2,300,000 „

Say one-thirtieth.

Opinions are unanimous as to the insufficiency of the wooded surface of this country.

The Municipal Council of Tlemcen has unanimously adopted the conclusions of a report in which it is stated :—

"You have all remarked, Gentlemen, that years of drought follow the detimbering which is going on. Numerous springs

are dried up, and the yield of those which we so much admired, and which used to supply us with abundance of water, has diminished by one-half. With respect to France, it is generally acknowledged in theory, as well as a practical necessity, —as much in regard to climate as in view of keeping up a supply of wood for fuel and for constructive purposes—that *one-fifth* of the area of her territory should be reserved for the culture of forests. We may therefore admit, without laying ourselves open to the charge of exaggeration, that in Algeria, on account of its elevated temperature, hot winds, and the aridity of the neighbouring countries, the timbered portion should be increased to *one-fourth* of the total area."

COCHIN CHINA.

Total area	...	...	6,540,000 morgen.
Timbered	...	...	930,000 „

Say 13 per cent. of the total area.

MARTINIQUE AND GUADALOUPE.

The forests occupy from 20 to 25 per cent. of the total area.

BELGIUM.

Total area	...	...	3,530,000 morgen.
Timbered	...	...	564,000 „

The importations exceed six millions of cubic feet.

In 1854 the Government promulgated a Forest Code, containing severe penalties; and in 1864 established a School of Forestry at Bouillon.

GERMAN EMPIRE.

Total area	...	...	63,372,600 morgen.
Forests	...	...	16,454,780 „

or a little more than a fourth of the total area.

Forests are regarded in this Empire as an element essential to the national prosperity, and are, therefore, conserved and treated with scrupulous and attentive care.

A law of the Kingdom of Saxony enjoins the State to acquire all forests of which the public interest demands the conservation.

AUSTRIAN HUNGARY.

AUSTRIAN CIS-LITHUANIA.

"The north-western region, comprising Bohemia, Moravia, Silesia, and the plain which occupies the left bank of the Danube in Upper and Lower Austria—that is to say, the richest and most populous provinces of the kingdom—is a country whose forests occupy 29 per cent. of the total area." "Here," says Mr. Wesseley, "is a community of pre-eminent intelligence in whose midst forestry societies flourish; where the forests, instead of being stocked, as those of other parts of the Empire, with the species implanted by nature, are composed of the varieties which the hand of man has substituted for them. The

latter have been planted partly on account of their complying more satisfactorily with the demands of consumers, but chiefly on account of their superior value from an investor's point of view. It may, therefore, be said that in this region the forests are the work of man in a sense similar to that applicable to agricultural or industrial productions. Several railway companies use wood as fuel in their locomotives."*

Austrian Trans-Lithuania.

The forests of Austrian Trans-Lithuania have not been examined sufficiently for us to state their area. This region, however, is abundantly stocked with timber.

The excess of exportations over importations amounts to £2,335,100; nevertheless, Austrian Hungary, with all its wealth of timber, is none the less compelled to carry out works of replanting.

The "Karst" Desert, how caused.

The coast region, from the Duchy of Gorz and Istria, to the southern extremity of Dalmatia, including the slopes of the Alps abutting upon them, was formerly flourishing and fertile, inasmuch as it was protected by fine forests, whence the Romans, and subsequently the Venetians, obtained timber for ship-building. But abuse of pasturage, reckless felling, and grubbing up, have caused a large portion of these forests to disappear, and the region has been transformed into the stony and sterile desert called the *Karst*, with some few and thinly-wooded patches scattered over it like oases. Great efforts are being made, however, to replant this region.†

SPAIN.

Total area	58,140,000	morgen.
Forests	5,930,000	„

of which a portion is brushwood.

The quantity of timber is notoriously very insufficient, and an Act, dated 11th July 1877, provides for replanting, which operation is entrusted, like the administration of the woods, to the Corps of Ingenieros de Montes, recruited from the Forestry College at the Escurial.

ITALY.

Total area	34,418,880	morgen.
Forests	4,712,000	„

In Italy also the necessity has been proved for extending the timbered area; and in 1877 a law was passed, designed to protect the forests, and to give an impulse to works of replanting.

GREECE.

Total area	6,046,000	morgen.
Forests	950,000	„

Say 15 per cent. of the total surface.

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* Report made on the Vienna Exhibition by Professor Mathieu.
† Report by Professor Mathieu on the Vienna Exhibition, 1874.

ROUMANIA.

Total area	...	17,790,000 morgen.
State forests	...	950,000 „

I have no exact data of the extent of private forests.

These particulars have been collected by M. B. de la Grye, French Forestry Expert, charged by the Government of Roumania with making a reconnaisance of the forests of the country.

TURKEY IN EUROPE.

Total area	...	31,400,000 morgen.
Forests	...	1,657,000 „

TURKEY IN ASIA.

Total area	...	145,000,000 morgen.
Forests	...	3,284,000 „

These extents have been estimated by M. Bricogne, Forest Expert, whose services the French Government had much pleasure in placing temporarily at the disposal of the Ottoman Government.

UNITED STATES OF AMERICA.

I have not, at this moment, documents sufficiently precise to enable me to give figures. The data of those, however, which I have before me, show America to possess very rich forests; but she is considering what measures should be adopted in connection with the decrease of her timber. Several of the States have passed laws for securing the replanting of their territories.

From this cursory examination of various facts, it will be seen that even those countries, possessing the fewest forests, are much better wooded than the Cape Colony is, even if my estimate of its timbered area were too low by one-half or more. But the Colony possesses excellent kinds of indigenous timber.

Very small extent of forests in Cape Colony.

Indigenous timber.

The small quantity of forests which it includes would suffice, if properly conserved, improved, and enlarged, as regards the present, for the requirements of a population still few in number relatively to the extent of its territory.

Present forests of the Colony might under proper treatment supply its present wants.

Finally, the exceptionally good nature of the soil renders success certain if the work of planting the mountains and the sandy coasts is undertaken with determination.

Excellent nature of soil and prospects of success in replanting.

But the development of the Colony is, at this rate, like the idea expressed in these words:—"Forests precede a population and deserts follow it."

(End of Part II.)

PART III.

RECOMMENDATIONS.

Examination of Crown Forests.

The Colony possesses very few forest in comparison with the extent of its territory.

Survey of Crown forests.

No time should be lost in examining with the greatest care all those portions of the forests which belong to the Government, and, in conducting such an examination, to make a classification of their contents;

Conservation urgently necessary.

and they should also be surveyed by making a plan of the untimbered area necessary for their maintenance, while steps should be taken as soon as possible in regard to most active measures for ensuring their conservation.

Question of ownership to be promptly decided.

The question of ownership should be decided without delay, at least in so far as concerns lots in litigation in order that the true owner, whoever he may be, shall be able to look after his own interests, in the case of a private property, as well as for the public interests in that of property vested in the Crown.

Purchase of forests.

By a practice analogous to that recognised as necessary in Sweden, in the Kingdom of Saxony, and also in France, if, in the recently annexed territories, such as the Transkei, for instance, or elsewhere, there are forests, endeavours should be made to acquire them; this being the only means of preventing their spoliation, and ultimately their complete ruin and destruction.

Reason for conservation of Crown forests.

The Crown forests ought to be conserved and improved with all the more care on account of their limited area. The chief cause of their destruction is fire.

In order to preserve the forests from fire, it is necessary, first,

Preservation from fire.

to clear the borders of the forest by burning in winter the grass which covers the ground, as is now done by Captain Harison.

Clearing away débris.

In the second place, we must clear the forest by removing the *débris* of felled trees.*

Fire-paths, to arrest progress of flames.

The next step will be to cut, at intervals of about every 200 yards, paths which will serve the double purpose of arresting a fire, and of facilitating the removal of timber, while at the same time contributing to the proper surveillance and control of the forest.

Stock of seeds and plants.

Finally, there should always be a sufficient supply of seeds in store and of plants in nurseries, in order that as soon as the ground has cooled the burnt tracts may be replanted.

* Waggons and oxen should be placed from time to time at the disposal of Captain Harrison, to enable him to clear the districts where timber has been felled. The proceeds of the sales would more than cover the interest on the capital expended.

It will be necessary to decide whether the foregoing measures are legally applicable to Crown forests situated in the midst of farms, as well as to those in locations.

Crown forests on private farms.

It will have to be determined also if it is necessary to introduce an Act embodying preventive measures, setting forth responsibilities, enabling repressive measures to be enforced, and supplying the void which now exists in our colonial legislation with regard to forests.

Legislation on Forestry matters.

Our forests are far from producing, either in material or in money, such results as the active nature of the growth of trees and the consumption of the Colony would lead us to infer is the case.

Present general management.

Investigations must be made into the age at which the trees may be felled, and into the capability of each forest.

Special instructions should be drawn up on this subject in regard to each forest lot.

Special instructions for each forest lot.

Among the species which stock the forests two kinds alone are very much sought for, *viz.*, stinkwood in the conservation of the Knysna, and sneezewood in the Eastern Districts.

Demand for stinkwood and sneezewood.

The system of felling by license has a tendency to cause these two woods to disappear.

Objection to license system.

In order to increase the production in material and money, and to keep up the supply of the foregoing valuable species, the ordinary fellings should be rated or assized according to the limited areas on which the material for disposal and that reserved shall have been previously noted, clearly indicated, and invariably marked. The part of the forest destined for felling should be sold at so much per foot by public auction, in order that the felling may be made conformable to the clauses of the conditions of sale.

System of sale of stinkwood and sneezewood by public auction.

In cases where existing circumstances may not render a public sale immediately desirable, agreements for felling should be made upon conditions as near as may be to those of public sales, or licenses should be issued with due regard to the *defined contents* and under similar conditions, or the Government itself might undertake the felling.

Restrictions regarding sale and felling of sneezewood and stinkwood.

Thus, by following one or other of the foregoing modes of procedure, we should eventually arrive at the best system of selling by public auction.

As a temporary measure, at places where there will be large contracts in course of execution, endeavours should be made to arrange with the contractor reasonable conditions for the extraction, on his own account, of timber which, in the interests of the forests and of the public, should be removed.

Fulfilment of Contracts.

Decayed wood, removal of.

At the same time a certain number of the superfluous and decaying trees, scattered over various districts, should be noted, marked, and sold, or cleared away, either in independent lots or in groups.

Stinkwood and sneezewood, growth of to be cherished.

Forestry operations should be conducted in such a manner as to encourage as much as possible the replenishing diffusion and growth of stinkwood and sneezewood in their respective districts.

Stipulations in felling licenses.

It being a principle that those who cause damage should make it good, and as felling always causes some waste in the forests, contracts made with purchasers, contractors, and licensees should always stipulate the number of working days allowed, in order that the Conservator may utilise these days in the manner most advantageous to the interests of the public.

Transport of timber. Roads.

For the purpose of facilitating the removal of the timber, and consequently its sale, waggon-roads should be constructed in all the forests where practicable.

Portable tramways.

A movable section of the Decauville Portable Tramway* should be available for each forest, and, being laid along the fire-paths branching out from the waggon-roads, would thus form feeders to these main roads or base lines of communication where felling is going on.

Clearing for new roads; co-operation of departments.

Whenever a new road has to be made through a division or district containing forests, the departments of Public Works and of Woods and Forests should co-operate in order to ensure that, in clearing away the trees, the felling of timber should be strictly limited to as much only as is absolutely necessary for the execution of the work.

Sawing-mills with water power.

Sawing-mills should be constructed near water-courses, and could use the water as their motive power, as well as at points situated between districts where much timber would be sold in small quantities; and at stations, whence it could be forwarded to other parts of the country.

Nurseries for replenishing forests.

In order to ensure the replenishing of the stock of trees, a nursery should be established in the vicinity of every district where felling is

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* The "Porteur Decauville" is a small portable railway, patented in France, England, Austria, Belgium, &c.

It took the First Gold Medal at the meeting at Galway; and the inventor received the Cross of the Legion of Honour at the Universal Exhibition of 1878.

The line is composed of a series of sections of single lengths from 15 to 16 feet long, weighing from 110 to 120lbs., each capable of being put in position instantaneously without addition of cross pieces (or sleepers) of any sort.

The width of the way (the gauge) is from 18 inches to 2 feet; it costs at the factory from 4s. to 6s the yard run. Waggons (carriages) adapted to the transport of wood, for earth works, and transport of supplies of all sorts, &c., are manufactured at the same factory.

going on; and particular care should be bestowed each year upon collection of seeds of the best kinds.

As regards the plots of ground to be planted in, the work must be carried on, according to circumstances, either by sowing or by planting; and there should be special instructions issued applicable to each lot.

Immigrant allotments.

In the divisions of George and of the Knysna, in determining the land to be allotted to immigrants, the basins in which water-courses take their rise should be reserved, as well as the slopes between which they flow, and, along the sides of the hollows, a zone of a breadth sufficient for the proper protection of the slopes. Co-operation between the Immigration Department and that of Woods and Forests would ensure the carrying out of these arrangements. I have reason to believe that the cost of replanting per morgen would not be excessive.

Government reservations on above.

Replanting lands.

In the first place, the Government still possesses sufficient land in the districts where re-wooding is most necessary, so that, for a long time to come at least, there would be no necessity to employ in the purchase of suitable land any large portion of the funds set apart for that purpose; while in many places plantations by seeds, protected from fire and from cattle, would suffice for the formation of new forests.

Examination of forest lots and reports thereon, before sale of Crown lands; and reasons for so doing.

In every case it is urgently necessary to provide for examinations from a forester's point of view, the results of such examinations being embraced in special reports, and always henceforth to precede the public sale of Crown lands. This course furnishes the only precaution possible against the sale of land on which reforesting is desirable; and this should be done whether any forest exists on the land or not, so that no necessity should arise for sooner or later purchasing lands at a price far in excess of their actual value.

Classification of Crown land lots.

In order that this precautionary measure should not too much embarrass the sale of land, these examinations should be first made with regard to surveyed lands, and afterwards of those lots on which surveys are in progress, classifying the Crown lands under pieces which should be reserved for wooding, and those which should be sold.

Forest land described in detail.

Under the head of "Forest Land" should be classed the following:—

1st.—Ground devoid of vegetation, and situated on the summits or slopes of mountains, extending to a level to be ultimately fixed for each division. Care should also be taken to specify those parts of the soil where forests are considered necessary as giving shelter from wind, and becoming condensers of atmospheric moisture.

2nd.—All ground having steep slopes, and those subject to erosion by water; and particularly those covered with *débris* of rocks, and shifting earth liable to be carried away to the mouths of rivers.

3rd.—Belts of land on which trees would be useful to protect the soil against erosion by rivers and torrents.

4th.—Lots necessary to form in each natural basin a wooded surface sufficient to control the action of water along their sides.

5th.—Tracts which should be wooded in order to protect the dunes and the coasts against the encroachment of sand and the injurious consequences of wind.

6th.—Ground which may be specially adapted for the growth of stinkwood and sneezewood, in order to satisfy the future needs of the Colony as regards these two valuable kinds of timber.

7th.—Ground surrounding railway stations and platelayers' cottages, or traversed by the different lines of railway.*

8th.—Ground, which can be most easily wooded, in localities where there is not, within a radius of 35 miles, a sufficient number of lots reserved under the conditions already stated with regard to timbered forests, occupying at least a tenth part of the territory, whose needs with regard to timber require to be satisfied.

Replanting of Bushes.

The formation of pine forests from seeds should be tried in those localities where only firewood is at present produced. Special instructions should be laid down for each lot.

Experiments with various kinds of trees.

Trees used in manufactures, the olive, mulberry, oak, cork, &c., should be tried on lots which appear to suit them, and which could be subsequently let or alienated without injury to the forest.

Land on the flats for experimental purposes.

A piece of ground should be selected on the flats, for making experiments with trees whose introduction would be profitable, where we could watch their growth, study their characteristics, and observe, also, the effects of the treatments applied to the various kinds found in different parts of the Colony.

In Europe such plantations are held in very great value.

The German Empire alone possesses *seven* forest nurseries. According to Dr. Baron de Seckendorff, Director of Plantations in Austria, and founder of the Plantation at Vienna, the object and usefulness of these establishments are thus described :—

Forest nurseries—aims and objects.

"The object of these forest nurseries is to proceed with method and perseverance in experimental forestry, and to make observations with a

* In pursuance of Resolution No. 3 of 1880, of the Honourable the Legislative Council.

view to ascertain the practical and reasonable principles on which forest operations should be applied to the conditions of a country, as well as to discover and make known the influence which forests exercise on the physical economy of a country, upon its soil, and upon its climate.

"The means of creating, conserving, and profitably dealing with forests are to be studied; also their extension, and the different modes of their cultivation, in order to discover the enemies of the trees, such as insects and *fungi;* and what means should be adopted to exterminate them. The machinery, tools, and contrivances for transport, necessary for the working of timber forests, must also receive attention. Another object is to obtain suitable outlets, and to discover the best processes for the utilization of the productions of the forests. In one word, these institutions take the initiative in all researches, with the view of drawing from the forests, with the minimum of expense and labour, the maximum of profit, and thus to augment the public revenue."

Locality for creation of necessary forests.

From a climatic point of view forests are absolutely necessary on the mountains extending from Komsberg to Compasberg. It is there that a great many of the rivers of the Colony take their rise; and, moreover, if the north-west winds reached the Karoo after passing over forests, they would very probably pour down on the dry plains a larger quantity of rain.

Planting of sandy dunes.

Planting the mountains of the Kareeberg would exercise a salutary influence on every portion of the divisions of Fraserburg and Victoria West, comprised between this chain and the Nieuwveld, as far as Prambarg. The westerly winds would be cooled, and would bring more rain, if the sands on the Western Coast were planted.*

Planting along banks of the Orange River.

Finally, plantations on the heights, destitute of timber, which command the banks of the Orange river along a portion of its course, would cool and moisten the north winds to the advantage of the whole country.

Effects of planting the mountain sides and sandy dunes.

The planting of the mountains and of their slopes, combined with similar operations on the edges of streams, would bind the soil together; while plantations on the dunes would fix the sands, and then, at no remote date, perhaps, the mouths of certain rivers, now closed, would become practicable for navigation.

Mountainous locality recommended for planting.

I do not hesitate to recommend this work to the most earnest consideration of the Government. I am of opinion that it should be commenced on the mountains situated to the south of Beau-

* I have described, in a pamphlet on the Sandy Dunes of the Coubre, the entire process of fixing sands

fort; and, I believe, having already made an examination of these districts, and from particulars gathered on the spot, that there is every prospect of success in carrying it out. I am supported in this opinion by Captain Harison, with whom I have conferred at length on the subject.

Funds to be provided by alienation of Crown land lots.

With regard to the ways and means of creating the funds necessary to be provided for the expenditure which an undertaking of this nature would necessitate, I think they could be partly furnished by the alienation of lots, small in extent (say 10 morgen), of Crown lands, which, for this purpose, might be sold in detail. Large tracts of these lands exist in the portion of the division of Humansdorp, known as the Tzitzikama.

Advantage of above alienation.

An alienation under these conditions would satisfy the needs of many people; would encourage the formation of small holdings entirely cultivated, in lieu of large undefined extents of pasture lands periodically burnt; would attract to the country a numerous population, and would produce a considerable revenue for the Treasury.

Utilisation of timber.

If, as I have been told, the woods of the Colony have been properly tested, the results of these tests should be searched for. If necessary, fresh experiments should be made, in order to confirm and verify the former.

When the value or worth of these woods shall have been officially and indisputably determined, they should be employed in colonial public works for which they possess the requisite qualities. Care must be exercised, however, that the trees are never felled out of the proper season. We should follow the system of *conservation* which prevails in Europe.

Test sales for popularising use of the Colonial woods generally.

In order to render popular in the Colony the use of certain kinds of timber hitherto but little used, though of acknowledged good quality, it might perhaps be better to dispose of on account of the Government, and in marketable sizes, a certain quantity of properly selected timber, which should be sent to the principal markets of the Colony for the purpose of being publicly sold.

Manufacture of charcoal.

There is scope for inquiry as to whether the branches of the trees cannot be profitably converted into charcoal.

Staff.

In order to conserve and improve the forests of the Colony, and to increase their production for useful purposes, as well as to create the timbered surface necessary, officers should be appointed for this work, and there should be an organisation to render individual effort efficacious by means of co-operation. I think that such a staff should be gradually organised.

Forest conservation of the Knysna.

The divisions of George, the Knysna, and Humansdorp, constitute the Conservation District of the Knysna.

Operations of Capt. Harrison.

The Conservator, Captain Harrison, has indeed done all that he has been able to accomplish, under the circumstances in which he has been placed, towards protecting the forests entrusted to him. He has carefully followed the instructions contained in the Regulations so as to insure felling the trees at the proper season. His efforts have been attended with no great results, because the system of licenses does not allow of them; but he has, nevertheless, made efforts to localise the felling of timber to places where supervision was possible, and also for the removal of mature trees from the open sections. He has prevented the total disappearance of stinkwood from certain lots by forbidding the waste of this precious and rare kind for purposes for which wood of less valuable species are suitable.

He has rendered real service by insisting on the use of colonial woods for sleepers and telegraph poles.

He has busied himself in keeping woodcutters employed around the forests.

He has shown true discernment in the recruiting of his staff, being aware that the functions of ranger cannot be properly discharged except by respectable men drawn from the labouring classes, who will not endeavour to escape from the hard daily work which their occupation necessitates, and having the degree of intelligence and the information necessary for the due discharge of their duties.

He possesses a thorough aquaintance with the woods, climate, and soils of the districts. He has experience in the service, and instead of confining himself to running in the usual groove, he has not ceased to search for improvements and to recommend them.

Whenever his assistance may be required in making the dispositions necessary for the management, improvement, completion, and extension of the forest scheme of this district, I have no doubt that his experience will be very useful, because experience is combined in his case with a mind amenable to all progress.

Additional ranger for Knysna forests. Mr. Dunn's contract.

At present it appears necessary to appoint an additional ranger in the Forest Conservation of the Knysna, in order to supervise the felling in the locality where Mr. Dunn is preparing the 500,000 sleepers comprised in his contract.

Eastern provinces.

The omissions and absence of co-operation in the forest service of the Eastern Provinces have been referred to in before.

Before undertaking in this district what is necessary for the conservation of these rapidly-decreasing forests, it is absolutely essential that a superior forest officer should be appointed for the purposes of centralising the correspondence, administering the primary preservative measures against fire, as well as against the unseasonable destruction of young saplings and felling of timber; and to initiate investigations as to the durability and the felling of the timber, together with the capability of the forests.

Superior forest officer, Appointment of.

This officer should possess the following qualifications:—

Qualifications of above officer.

A knowledge of timber;

A knowledge of the country;

A knowledge of the laws of the Colony and of the regulations of its Civil Service.

He should be of such age, education, and social position, as would permit him to associate, on equal terms, with Civil Commissioners.

He should possess sufficient activity to enable him to make the extended investigations in the forests which his duty demands.

As has been remarked before, a ranger at Kieskama Hoek, as an Assistant to the Conservator, would be of great service.

A third functionary is indispensable to the Colony, for the works of replanting on the flats, for those to be undertaken at Beaufort, for the plantations to be continued there, and for general forestry service in the Western districts.

Officer for replanting and general forestry work.

In my opinion, for the purposes of determining the yield, and making an inventory of the material of the forests, and for stimulating the activity of the other branches of the service, it will be necessary to procure the assistance of an experienced forester, from the class of head-ranger (to be styled "Sub-officer, or Brigadier, of Forests"), having a thoroughly practical acquaintance with all the details of forest work, and able without delay to set the staff of colonial rangers at the work which forestry operations and fellings of timber for sale render necessary, including surveying and levelling.

Employment of a brigadier.

An assistant of this class was given in 1866 to every French agent charged with the survey of the forests of Turkey; and in this country, where it is necessary to establish a regular and permanent system for all the details of the Forestry Department, such a course is even more essential than it is elsewhere. No time, therefore, should be lost in satisfying this want.

This organisation, when completed, will suffice for initiatory measures; but as soon as the mode of felling by agreement shall come into vogue,

Organisation of the forestry staff.

and the execution of forestry works, in addition to those proper to the conservation, improvement, and development of the forests, shall be decided upon and commenced, each superior officer will evidently need capable assistants, similar to those who are trained to assist heads of service in India, and who will in course of time take their places.

It has long been acknowledged everywhere that in order to take care of the forests we require officers who will study the trees from an economical point of view, as scientists and botanists do; who understand the cause and principles of growth and decay; who can prove, by demonstration, the experiments they make, and at the same time justify an axiom by experience; and who will be competent to direct works in connection with felling and replanting.

Training of forest officers.

The British Government, as the result of experience, has come to the conclusion that the best training is given in the School of Forestry at Nancy, and has entered into an arrangement with the French Government, by virtue of which each year a certain number of young men are selected to pass through the curriculum of that school. During their stay at Nancy they are under the charge of Colonel Pearson, formerly Conservator of the Forests of India.

Colonial young men recommended to be trained in France for forestry work, &c.

I would submit that the Cape Government should, without delay, select four young men in the same manner as is done by the British Government; and since they would be, as colonists, British subjects, it would suffice, I imagine according to the terms of the existing arrangement, to negotiate with the British Government to this end, in order that no obstacles or delays may intervene. I consider this step as the best possible that can be taken in the future interests of the Colony. The session of the course at Nancy usually opens early in November, and the duration of the period of study is from two to three years. There is, therefore, not a moment to lose if advantage is to be taken of the ensuing scholastic year.

Special services rendered by Forest Department of France, &c.

In France, forest officers are exempt from military service, strictly so-called, but they constitute an auxiliary army corps, which rendered eminent services during the invasion.*

I think that a similar organisation could be made as regards the Forest Service of the Cape Colony.

(End of Part III and of Report.)

* See the commendatory remarks of the Duc D'Aumale, with reference to the Bazaine Trial, and the letter from General Gambriels.

CONCLUSIONS.

Summing up of operations recommended.

The general view of the course thus marked out comes under three heads. :—

1*st*.—The application of the best possible treatment to the existing forest lands.

2*nd*.—The introduction of timber trees among the bushes.

3*rd*.—Planting trees on lands where forests are necessary.

Ends to be attained.

These three measures, pursued with energy, confidence, and perseverance, will lead to the following results :—

1*st*.—To draw from the Colony itself all the wood necessary for its own consumption. By this means an annual sum of £500,000 or more will be expended here instead of as at present, paid to foreigners; this is borne out by the Custom House Returns of Importations, and will, without doubt, lead to a greater increase of wealth in the future, in preparation for becoming a wood-exporting country at a time when wood will be more scarce in other parts of the world.

2*nd*.—To regulate the water-courses, and render drought, from which under present conditions the Colony suffers less frequent.

3*rd*.—As a consequence of these two effects the development of colonization will be powerfully helped forward.

The teaching of Forestry at the Central Forest School, Dehra Dun.

FORESTRY being an art founded entirely on the observation of natural phenomena and the correct application of principles deduced therefrom, one of the most certain tests of a forester's aptitude for his profession is evidently the composition of a paper on some sylvicultural subject, to which he has devoted special attention. Accordingly, at the Central Forest School at Dehra Dun, it was decided to require the students, who were just completing their probation during the past session, to write an original essay on some subject selected by themselves, the essay to form an integral part of the final examination in forestry. This decision, for reasons which could not be helped, was only communicated to the students a fortnight before the examination, so that they had not the advantage, almost indispensable it must be admitted, of having previously followed out a connected series of observations all bearing on the one subject selected. Nevertheless, the essays are, I think, a fairly satisfactory proof of the progress made by the men, and as they will not only serve to give to the general public some idea of what we have been teaching at the Central Forest School, but at the same time also help to show to Indian

foresters, the class of men we are preparing for the subordinate grades of our department. I send you selections from them for publication.

Critical readers will please to remember that these men form the first batch, who have gone through the entire course of instruction followed at the school; and that it is not from among the alumni of our Universities, men possessed of a high degree of general culture, that we can draw our recruits.

The men are all natives, and it would hence be superfluous for me to add that English is a foreign tongue for them.

The matter concerns us much more than the style and phraseology. I have, therefore, corrected the language of the extracts in so far as to make it intelligible English: the substance remains unchanged.

THE DRY RAKHS OF THE PUNJAB.

By Daulat Ram Bimbhat.

The word Rakh is a Panjabi word, derived from Sanskrit *Raksh*, which means some thing reserved or protected.

Formerly all the villagers, who lived inside, or in the vicinity of the rakhs, were permitted to pasture their cattle free in the rakhs; but since the Forest Department has come into existence, grazing dues are levied.

I would confine my remarks simply to those rakhs, which go by the name of Bár, and lie between the rivers Ravi and Chinab, between parellels 31° and 32½° of North Latitude, and 71° and 73° of East Longitude.

This tract of land lies in the arid zone, where the rainfall does not exceed 15 inches. The fall diminishes as we go south-west. For instance, a little beyond Mooltan, it is only 7 inches.

We are here in the alluvial plains of the Punjab. Crossing the Ravi from Lahore, we find the soil at first free and quite moist from sub-soil percolation; wells can be easily sunk, and at little cost. As we go further, the land rises slightly, the soil looks fertile, but is destitute of sub-soil moisture, and agriculture is carried on by means of very deep wells, from which the water is lifted with Persian wheels. A single well is sunk by several cultivators clubbed together, and each one uses it in turn. The scarcity of water is so great that the wheels are worked day and night. As we advance further into the interior of the Doab, the depth of the water-bearing stratum increases, and the country has almost the appearance of a desert.

The soil consists of a very hard clay, which is often saline, and rings with a strange hollow sound under the tread of horse or man. As all the vegetation on the ground consists of a few shrubs and scattered tufts of grass, with small trees here and there at long intervals, the soil is caked and hardened by the direct heat of the sun, helped by the continual treading of

camels, buffaloes, cows, &c., which roam over it in thousands during the rainy season. The clay is so stiff and plastic that the footprints of goats, sheep and cattle remain faithfully impressed in it; and, when rain falls, the greater portion of it runs off superficially, very little being able to get into the soil.

The climate of the tract I am describing is milder than that of many other places in the Punjab. The people are strong and healthy.

The chief, as well as the largest tree, is the *Prosopis spicigera* (jand), mixed with *Zizyphus* (bér), *Salvadora oleoides* (van), and *Capparis aphylla* (karir), and, in some places, where the rainfall exceeds 15 inches, with *Acacia leucophlœa* (reru). There are a few other species besides, which are however of little or no value. Even the *Prosopis spicigera* is, at the best, only a moderate sized tree.

In spite of the hard and stiff soil and subsoil, which keeps back or excludes other species, the jand is able to remain easily the dominant tree (although a stunted one), thanks to its long and strong taproot, which has been known to penetrate 60 feet into the ground. The jand thrives best where the rainfall is between 15 and 30 inches, and disappears altogether where this latter exceeds 40 inches.

Its small, flat seed is caught in the numerous crevices and holes to be found in the clay soil I have already described, and is not easily washed away like the large round seeds of *Zizyphus*, *Salvadora*, and *Capparis aphylla*.

The seed is shed in the months of June and July, just before the rainy season, and is not injured by the strong heat of the sun. When rain falls, it germinates readily, and at once develops a strong taproot capable of forcing its way into the ground.

Jand is long-lived and long-suffering. Although it is treated very badly both by men and animals, who cut it down year after year, tear off its bark, and nibble off its terminal shoots, it still holds its ground. Rai Melá Ram, the great fuel contractor of Lahore, stubbed out the roots of this tree from his private rakhs, but an abundant crop of root-suckers took the place of the trees that had disappeared.

Jand is proof to the severest heat and frost. In the Kot Lakhpat plantation near Lahore, where the climate is excessive, babul is killed down to the ground by frost year after year, but the jand flourishes without the slightest trace of injury.

Thanks to its small leaves, narrow crown, and long tap root, the jand has nothing to fear from violent winds, which uproot or mutilate many of its companions, especially reru (*Acacia leucophlœa*.)

The seed of the jand possesses great vitality. I once sowed some seeds which had been gathered two years previously, and kept without any care. They had been heaped up on a kutcha

floor, exposed to dry and moist winds. They germinated very well.

In connection with the faculty which the jand possesses of throwing up root-suckers, I may say that I have been told that it may be propagated, like sissoo, by means of root cuttings. My experiments to test this peculiarity failed, but I am afraid I worked out of season.

All the peculiarities I have just given combine to render jand a gregarious tree. Nevertheless one may ask why, if jand is so hardy, and able to flourish under the most adverse conditions, the rakhs are so badly clothed with trees. I would reply as follows:—

I. These areas have not yet been reserved. The rights of surrounding villagers are not defined or settled, and no thought is given to the regeneration of the forest.

II. Grazing is unrestricted. Seedlings are greedily devoured by goats and buffaloes. The young foliage, terminal shoots and flower-bearing branches of young trees are torn or eaten up directly by camels, while those of larger trees are bent down, broken, wrenched or lopped off by the herdsmen armed with long pruning hooks. Often the bark is torn off right down to the base of the stem.

III. The ripe seed (*Sangar*) is gathered, and is a favourite article of food with men and cattle. People gather the seed by thousands of maunds, and sell them in neighbouring towns and villages. The seed collectors have no more mercy for the trees than the herdsmen.

IV. People go into the rakhs and cut how and what they like.

If the causes of destruction that I have just briefly stated are removed, there is every hope that we shall, in time, not only see the rakhs densely stocked, but the trees attain the maximum size of their race, and not remain as they are at present, mere stunted bushes.

When it is left undisturbed, jand has been known to attain a height of 60 feet with a girth of 9 feet.

Besides this, when in November last I visited the rakhs I am describing, on official duty, I came across many ruins of cities, villages, tanks, wells, and temples, and noticed, moreover, the dry beds of ancient streams and pools, which at once convinced me that this part of the country must, at one time, have been in a flourishing condition, and that it had since undergone a very sad change indeed.

Near the village of Mahandai, the head-quarters of the forest ranger, I found a very large dilapidated fort, and not far off the ruins of an extensive city, which, the villagers told me, had once been so powerful that it had repelled thousands of invaders from the frontier. The dry streams, which now flow only in the rains, must once have been perennial. But

now the whole region is a vast desert, studded with a few hovels of wandering lawless men, who graze herds of cattle stolen from the neighbouring agricultural districts. Among them no man may wear a turban, unless he has stolen something. During the hot weather men and cattle drink from the same pits, the water in which may be aptly termed liquid manure.

The importance of these rakhs, as fuels and grass preserves, is very considerable. They supply all the neighbouring centres of population, including Lahore and other large cities, with firewood and grass. They sustain a noble breed of cattle, sheep, and goats. In them are pastured thousands of camels, which mainly carry the Kabul trade.

I will now say what I know about the propagation of the jand. The seed ripens in June and July, and can easily be kept, provided it is protected against the ravages of mice, rats and insects.

I myself sow from April to May, and even up to the middle of June. In my opinion it is best to sow on ridges.

Another method followed is to sow on the sides of furrows or trenches, which also serve as irrigation channels. The Kot Lakhpat plantation was sown in this manner. The trenches are dug 10 feet apart and one foot wide. The soil on the western side is loosened, and the seed is sown in a single line, just above the height reached by the irrigation water. Germination takes place in from ten to fifteen days. Water must be given every alternate day until the seed germinates. In no case should water flow over the seeds or the base of the seedlings, as (I say this from my own experience) death will ensue in most cases. Water ought to reach the seeds as well as the young plants by capillarity. In the Kot Lakhpat plantation, 25 acres of blanks were successfully stocked by sowing on small mounds round which the irrigation channels passed. The earth below the mounds had been previously loosened, and the mounds themselves were made up with the lowest layer of earth loosened. The mounds were 10 feet from each other in lines 20 feet apart.

Jand may be cultivated in the poorest soils, even in what is called *Kallar* in the Punjab, but there must be a sufficient supply of moisture at the beginning.

THE KORAI TEAK FOREST.

By Chandra Kumar Chatterjee.

The Korai block is situated partly on the edge and slope of the Korai Ghat, and partly below the Ghat. Its area is about 31,000 acres.

Below the Ghat the soil is alluvial ; on higher ground it is disintegrated gneiss. Trap occurs near the edge of the Ghats, and is often capped with laterite.

Area for area, this block is more valuable than any other of the Satpura forests. It contains a very large propor-

tion of teak, which, for the most part, is straight and well grown, averaging 18 inches in girth. Teak is quite the dominant species throughout the area, and is mixed with bamboo, tinsa, dhaura, lendya, salai, achar, aonla, kusam, khair, dhaman, dhobain, padal, bijasal, saj, shisham, gulu, &c.

The forest has been protected from fire since 1872. Protection is effected by clearing and burning completely an outer line, about 400 feet wide. For the purpose of easily localising fire, in case one occurred, the whole area is divided into seven sections by burning an internal line 200 feet wide.

(1). Along the road from Rukhar to Sakadai, across the feeders of the Jamun and Bawanthari nullahs.

(2). From Rukhar to Jamun nullah.

(3). Along the Dongria nullah for about two miles, and then along the flat crest of a hill up to Sangaur nullah.

(4). Along the road leading from Chunderpur to Dorasee Khassa.

The result of fire protection in this forest is very marked, especially in the three compartments adjoining the Nagpur road. Young coppice growth, which, prior to the introduction of this measure, was either burnt down annually to the roots, or greatly scarred and thereby damaged, is now progressing in a satisfactory manner both above and below the Ghat.

The poles are straight, clean, and covered with healthy bark and foliage, and quite different in appearance to similar stock in the unprotected forest west of the road.

The soil, too, year after year, assimilates more vegetable matter, receiving back the chemical constituents drawn from it by the trees and grasses; and what is a matter for congratulation, a plentiful crop of seedlings, for the absence of which the forest was formerly conspicuous, is now springing up in all places, where the essential conditions of light, soil, and seed-bearing standards exist.

At Korai especially, where the above conditions are perhaps better than elsewhere, seedlings of teak saj, khair, and rohan are rapidly filling up the small blanks adjoining seed-bearing trees, and where these latter are present in fair numbers, it is certain that we may rely on the forest being regenerated by natural means. The growth of these self-sown seedlings, however, remains very slow, and they appear to require many years of uninterrupted protection before they attain even the height of our forest grasses. They may, however, be assisted by being relieved of the pressure of the surrounding and superincumbent grass at the beginning of the rains, obtaining thus a a free circulation of air, light, and room, for the spread of their small roots.

Experiments in the copsing of teak were undertaken in the Korai forest in the year 1877. The area chosen for the operation is situated between Rukhar and Sorkadongri. It contained

a very large amount of coppice teak, a large portion of which had been damaged by former fires, and from which it was hopeless to expect a future supply of timber. All such damaged trees were cut back over an area of 1,500 acres. 10,006 trees were so felled, yielding only 5,123 saleable poles. No better proof of the necessity of the work could be found than in the figures above noted; the stock was so wretchedly bad, that for every two trees felled we could obtain only a single marketable pole! The cost of the above work, including the collection and carting of the 5,123 poles to the Rukhar Depôt, came to Rs. 581-3-2, *i.e.*, Rs. 11-2-3 per 100 pieces; 3,682 pieces were sold from the Rukhar Depôt during the year 1879 as follows:—

Small poles 3451 = Rs. 690-7-9
Large poles 2,31 = Rs. 83-14-3

3,682 = Rs. 774-6-0

thus realising an average rate of Rs. 23-11-7 per 100 poles, or scarcely more than 8 annas per acre. 6,363 trees left standing were at the same time freed from climbers.

The result of the experiment is a complete success. The trees were felled flush with the ground, and all the stools have thrown up vigorous shoots developed from dormant buds. Their average height in 1880, when they were three years old, was 16 feet.

A few strange cases were observed of stools remaining for a long time green, without developing shoots until towards quite the close of the rains.

A few then threw up shoots, others dried up, while the rest remained green up to my last inspection in 1880, but without having shown any sign of reproduction. I can offer no explanation of this strange freak.

Stools, containing from 20 to 40 concentric rings of growth, were the first to produce shoots, and these were generally more numerous and stronger than those developed on stools from 40 to 80 years old. On stools above this latter age, the shoots were very slow in appearing, and were few and weak in their after growth. But unless the trees or stumps were 100 years old and upwards, they appeared capable of being copsed successfully.

DEODAR IN KULU.

By Mian Moti Singh.

Forests in which deodar is the prevailing tree are generally found on moist loamy soils. The deodar affects northerly and westerly aspects most, although it is not seldom met with on other aspects. Indeed, the aspect it selects varies, as a rule, with the altitude at which it grows. For instance, between 4,000 and 6,000 feet above the sea the tree grows gregariously on northerly and westerly slopes, and less commonly on

easterly slopes, while *Pinus excelsa* very often forms pure forests on southerly aspects. Above 6,000 feet, on the other hand, it is on easterly and southerly aspects that deodar flourishes, growing there frequently almost pure, northerly and westerly slopes being occupied by the Himalayan spruce and silver firs.

The needles of conifers in the Himalayas form, when not burnt by fire, or triturated under the feet of cattle, a thick loose covering of undecayed vegetable matter over the soil. Deodar seeds that fall on such a covering, although they germinate freely enough, generally fail to extend their tap root, through it into the soil below, the result being that they are either washed away with the dead leaves by the spring rains, or are killed by drought. On the other hand, young seedlings of *Pinus excelsa* develop a tap root capable of piercing this loose mass of undecomposed leaves, and forcing its way into the soil, where they thus fix themselves firmly.

The Himalayan spruce generally produces from two to three crops of seed during the interval between one seed year of deodar and another. And hence, when these two species grow together, this circumstance alone, irrespective of some others, gives the former species a decided advantage over the other.

The advantages of having oaks growing with deodar are many. I may mention some of the principal:—First, the deodar by itself, or associated with other conifers, cannot form a complete leaf canopy. When oaks enter the crop, these broad-leaved trees fill up all the intervals between the crowns of the cedars, without, however, diminishing the number of the latter. They thus force and hasten the natural pruning of the cedar boles and they increase the production of the soil. Secondly, none of our oaks attain anything like the height of deodar, so that the former constitute a true undercrop, making growth on their own account, and pushing up the latter. Thirdly, and lastly, the mixed crop so obviously forms a much more complete cover over the ground, the soil being thus continually protected and improved.

The people in the Himalayas prefer the leaves of oaks as fodder to those of any other trees, and even to the various grasses themselves. Oaks are also cut for fuel before any other species. Oaks are, therefore, very heavily lopped, and are hence kept down or destroyed, so that where they might grow usefully with the deodar, pines and small broad-leaved trees remain the only effective, but comparatively inefficient, allies of that valuable tree.

It is a well known fact that young deodar is greedily eaten by sheep and goats; and that, although the stem of young seedlings is remarkably elastic, the heavy buffalo tramples down and crushes thousands of them under his broad cloven foot. I would, therefore, exclude grazing from every area that

is completely under our control. But when the undecayed layer of dead needles is so thick as to impede reproduction, I would admit cows in order to triturate the whole mass, facilitate its decomposition, and render it more compact.

Fires are not an annual occurrence in deodar forests, owing to the great altitude at which they often occur, and which preserves the moisture of the soil all the year round. But as the needles of conifers decompose very slowly, and are very resinous, they form a thick layer of highly combustible material, which, when once ignited, burns fiercely. Hence forest fires, when they do occur, are difficult to put out and do great damage. The only way to check or keep out fire is to trace fire lines, which should be kept clear of all combustible matter, and especially of cones. Unfortunately we have no deodar forests in the Punjab, which are thus protected.

SAL IN THE SAHARANPUR FORESTS.

By Kripa Nath Dey.

The Saharanpur sal tract extends from the Ganges near Hardwar to the Jamna, eight miles below Kalsi. The northern boundary is defined by the distinct watershed line of the Siwaliks; the southern boundary is marked by a well cleared line 15 feet wide.

This tract lies partly on the southern flank of the Siwaliks, partly on the flat ground below. The hilly portion of the area is cut up by deep ravines and gorges, with scarped and precipitous sides. The highest peaks attain an altitude of about 2,200 feet above the sea. The gradients of the slopes vary from 15° to 50°. From the ravines and gorges issue broad shallow water-courses called *raos*, most of which dry up in the hot weather, and the beds of which are flat expanses of boulders, water-rolled stones, shingle and sand.

Below the Siwaliks the soil is principally alluvial. The Siwaliks themselves consist of thick bands of shale, irregularly interbedded with conglomerates and boulder deposits.

The monsoon commences here about the middle of June, and lasts up to the end of September. In winter frosts are rather frequent and severe. Hot winds blow from the south during the summer months, bringing with them perpetual dust storms. The general aspect is southerly, but the sides of the spurs face respectively east and west.

Sal is the most extensively distributed of all species in these forests, and easily predominates or grows almost pure on the best soils, as in the Lakarkot and Ganjarban blocks, where it is associated with bahera (*Terminalia belerica*), Dhaura (*Lagerstræmia parviflora*), bhilawa (*Semecarpus anacardium*), jaman (*Eugenia Jambolana*), amaltas (*Cassia Fistula*), dhak (*Butea frondosa*), haldu (*Adina cordifolia*), aoula (*Phyllanthus Emblica*), and maljan (*Bauhinia Vahlii*).

Elsewhere, especially in the hilly blocks of Malowala, Dholkhand, Andheri and Bethban the sal occurs only in patches along the banks of large streams or on open level ground. There it is associated with sain (*Terminalia tomentosa*), sandan (*Ougeinia dalbergioides*), bákli (*Anogeissus latifolia*), bamboo (*Dendrocalamus strictus*), and chir (*Pinus longifolia*).

The new foliage of sál generally comes out in March, a few days after the old leaves have fallen. The trees also flower at this time. The seed ripens in June, and germinates immediately, often before falling from the tree, and an abundant crop of seedling springs up nearly annually, and covers the ground as with a carpet. The germination of sal is hypogeal.

The sal yearling develops a tap root upwards of two feet long, and is thus able to resist frost, and especially drought, well. Although both these causes may kill down the aerial portion of the seedlings, stronger and stronger shoots spring up year after year from the collum of the root, and ultimately shoot away upwards without any further risk.

The dimensions attained by sal in the Saharanpur forests vary according to the soil and aspect. On plateaux we find sound sal of 3 feet 6 inch girth and 18 or 20 feet to the first branch. Owing to generally unfavourable conditions, the sal in this tract becomes hollow at the centre at a very early age. It is common to meet with apparently sound trees that are quite hollow. The hollowness increases year by year, until the outside core becomes so thin that the trees are broken by the wind or snapped in two under their own weight.

Elephants commit a good deal of damage in various parts of the forest, especially in the Lakarkot and Ganjarban blocks, and also in the hilly portions. Their ravages have been chiefly confined to bamboos, which constitute their favourite food. Occasionally, we see the young sal trees knocked over by them.

The depredations of insects are very heavy. The grub of a certain species attacks sal leaves in the rains, and spares only the bare fibre. Last December nearly the entire foliage of coppice shoots was destroyed in this manner. White ants are very numerous and destructive.

At present there are in the Saharanpur forests, scarcely any sal trees fit for felling. The forest has been overworked, and now requires long rest and protection. The main sources of revenue are sales of minor produce and of dead and fallen wood of various species.

E. E. FERNANDEZ.

A trip through Chamba.

(*Continued from p.* 171.)

June 24th.—Moved camp to Kotwar near Bagai. Sent everything direct and went ourselves up over the Jaréd spur. This was a very steep climb, simply right up a mountain side. Luckily we started so early that we had shade nearly all the way. The hill-sides hereabouts are simply like walls. I am sure some of them must be at an angle of 60° or 70°; no one with a "bad head" could go about on these footpaths; some of the drops are very nearly sheer, and one looks down several hundred feet into a rushing stream below. It was a relief to get to the top of the spur and find ourselves once more in a forest; as of course our way being up the south side, was over an utterly barren country, too steep even for cultivation, except here and there in a corner. We passed a dirty "guddi" hut, and went inside to look at the beehives. All the guddies keep bees, not much trouble to them; they merely make a hole in the wall of their houses, and put a hollow tree trunk, about three feet long inside, the ends filled up with clay, and into this the bees' hive, and there, close to the cows and goats and dogs, and male and female guddies, they live a happy life in utter darkness, and an atmosphere that could almost be cut with a knife as an Irishman would say. Having reached the top of the spur we now simply went down the other side through the forest to the Jaréd stream. The upper part of the forest contained no deodar, but lower down there was a fair growth of ferns (*Lastrea nidus*), and some very fine *Aspidium ilicifolium*, 9 inches long, were the only uncommon ones. We crossed the Jaréd stream and continued along a fairly level path to its junction with the Mowa, the two below forming the Bagai nullah. After crossing this, we had several miles of the usual break-neck path along a perfectly barren hill side to the village of Kotwar, which we were very glad to reach, having done quite enough walking during the day.

June 25th.—Marched to Tikri, and then to Tisa, some nine or ten miles, an easy march, as it was fairly on the level; and at Tikri we joined a riding road. At Tikri, too, is the first of the "kothis" we have as yet seen. I had a sort of idea that "kothi" meant a house, and that there were rooms to put up in at each of them, but I was sadly undeceived. A "kothi" is merely a sort of rural kutcherry and granary, and a tent is preferable in every way to stop in. Some distance from Tikri there is a temple with some very fine deodar and *karun* (*Morus serrata*) girthing (deodar) 14 feet and 19, (mulberry) 20 feet, the latter hollow. Further on we passed the small forest of Garpari, containing mixed deodar and oak. At last we rounded a corner, and saw Tisa right across a steep valley, and soon commenced a steep descent to the Tisa bridge,

the road being hardly passable for ponies ridden. Half way down there is a spring of the most delicious water I ever drank, perfectly ice cold and crystal clear, coming out from under a big rocky bank. The Tisa bridge crosses one of the most wonderful channels to be seen, a narrow chasm with perpendicular sides, solid rock, and only 21 feet wide, and yet it is 160 feet to the water below. (I take the measurements from Dr. Cleghorn's sketch, page 110 of his reports). The sides of the chasm are parallel for a short distance, and then widen out, so that the width is much greater in the middle. From the bridge the road is very steep up to the village; past the Raja's kothi, on to the Forest House, a curious little place of four rooms badly situated on a bare hill-side, with a steep bank above it. On the way I found a fern quite new to me, which I am told is *Cheilanthis lzovitzii*. It is quite common here, growing with *Pellea nitidula* in the walls of the fields. We found Tisa quite hot, as bad as Chamba; it is altogether a most uninteresting place. During the next three days I halted at Tisa, I read Dr. Cleghorn's reports several times, as they go over the same ground as I am now travelling; but at page 98 there is a note that I should like to hear explained: he says that he was told by an intelligent guddi "who had been employed as a tea sorter at Holta," that the name of a certain root was "ishtapri," and supposes it to be *Polygonum bistortum*, but it seems to me that the name given by the intelligent guddi is suspiciously like our English "strawberry."

On the 29th we made a short march from Tisa to Makwa, a village about six miles up the Tisa nullah; there is only a footpath up to it, and as the sun was fully out, we found it hot, and were glad to get to our camp, which was in a very pretty flat place, between the two streams Kasnala and Bhared, surrounded by hill toon trees of great height and size, and many other kinds. We at once got some clean things, and rushed off to the Bhared nullah and had a bath. The water was, as usual, icy-cold, but we enjoyed it much, and our breakfast after, still more. In the afternoon we went a short way up the Bhared nullah to see what it was capable of in the way of floating logs. At present it is a mere rivulet, but appears to be swept by floods; in fact it is one of the usual Ravi streams generally containing very little water, but occasionally swept by heavy floods which clear out every log. Our procedure is to cut the logs, put them into the waterway, and then sit down and wait for the flood; if none comes, the logs will remain there till the crack of doom, and this is why logs, cut ten years ago, are still found in these feeder streams; they have been put in the waterway every year, but have either got jammed, left high and dry, or there has not been a heavy enough flood to take them down; of course it would not pay to guide them all the way down to the nearest large stream.

June 30th.—Rained pretty hard during night, and continued in the morning, so we could not get out till about noon, and then we went up the Kasnala, following the stream as far as we could; then up the bank and through the forest. It was not a nice walk, as, in addition to the path being very steep, it was through wet jungle; descended again to the stream, and then had to cross it four or five times over the usual hill bridges—"tangris" in the vernacular, not nice for a nervous man. The "tangri" consists of two saplings put across the water, and for footway slabs of slate are simply placed on the saplings; no attempt at fastening them in any way, and as they are generally on a slant, and there is a rushing torrent below, it is not very safe walking. I did not like to try it in nailed boots, so took them off, and crossed in my stockings—a very safe footing. Beyond these bridges we came to a grand sight—the whole nullah blocked up by an enormous mass of snow, 30 to 40 feet thick, and the water rushing underneath. The snow is said to have rushed down a nullah joining the Kasnala, in January last; and we were told that it would not melt entirely till August or later. We went over the top of the snow till we got to the stream again, and then sat down to enjoy the sight. Snow always fills me with a longing to do something mad. When I contrast the air about it with that of the plains, one can hardly realize for a moment that a very few hours comparatively can so completely change the scene as is the case in India. After gazing at the lovely view formed by the snow, with a background of blue sky, and on either side precipitous rocks with here and there a deodar, we had to rush back over the frail bridges, as we found that, owing to last night's rain, the stream was rising: indeed the last bridge was being swept by the waves as we crossed it. There are about hundred of our logs buried under the snow; we could see several of them close to the edge; it will be some time before they reach depôts. Next day we marched back to Tisa.

J. C. McDonell.

Cattle-grazing in Deodar Forests.

TO THE EDITOR OF THE "INDIAN FORESTER."

Sir,—I beg to invite the attention of the readers of the "Indian Forester" to the question of grazing of cattle in deodar forests, and will feel obliged for the expression of opinion on this important subject.

As for myself, I have had various opportunities from time to time, extending over a period of about ten years, of observing the effect of excluding cattle from deodar forests, and must confess that the result, as far as natural reproduction goes, has not been at all satisfactory.

When the conservancy of deodar forests was first taken in hand, the conclusion seems to have been naturally formed that it was absolutely necessary to exclude all kinds of cattle from such forests to ensure reproduction, often at a considerable amount of inconvenience and hardship to the neighbouring villagers.

My remarks refer principally to the forests of Chumba, Jaunsar, Bawar, Tair, Garhwal, Bussahir, and other hill states I have visited, and in most cases a comparison between forests left open, and those closed to grazing, by no means tends to show that much advantage has been gained by enforcing the closing process.

As a rule, as far as I have observed, the result of excluding cattle after fellings have been made is that a dense growth of grass and bushes of all kinds has sprung up, which, if it has not altogether prevented reproduction, has, at all events, hindered a large number of seeds from reaching the ground; and has also, probably, choked many young seedlings before they had time to overtop the grass.

On the other hand in the neighbourhood of closed forests one frequently observes patches of old deodar forest which are heavily grazed over, and in which a vigorous crop of young seedlings generally exists.

It may probably be argued by some of your readers that the real reason for the unsatisfactory state of affairs in the closed forests is that fellings have been made too severely or not executed on a proper principle; but this explanation can hardly, I think, be accepted in all cases, for I have often observed portions of open forests in which nearly all the trees have been felled by the neighbouring villagers, except the branchy ones left here and there; and in such areas, notwithstanding occasional fires and constant grazing, a magnificent crop of seedlings of all ages is often observable.

The probable cause of this satisfactory state of reproduction in the open forests is, that the grass and undergrowth has been constantly kept down, a certain amount of lateral shelter afforded by the trees left standing, and the feet of the cattle have tended to break up the turfs and thus enabled the seed to enter the ground.

On the other hand many seedlings are doubtlessly trodden down by the cattle, but on the whole I think the advantage seems to be on the side of satisfactory reproduction. It should also be observed that in such forests, the grass having been constantly kept under the damage done by an occasional fire, is very slight; whereas in the case of a conflagration breaking out in a forest which has been closed for 10 or 12 years, I think your readers will agree with me that "the latter state of that forest will be worse than the first."

It should be distinctly understood that I refer to the grazing of cattle only, for, although goats and sheep do not do so much harm in deodar forests, as they are supposed to do, especially when there is abundance of shrubs for browsing, still they undoubtedly nibble the top shoots of the deodar plants, especially when snow is on the ground.

It should also be understood that in places where sowings or plantings have been made, the entrance of cattle for a number of years, at all events, is of course out of the question.

As an example of what I have endeavoured to explain above, I may mention the case of the Koti deodar forest, situated in the Jaunsar Division, School Circle, N. W. P. Considerable fellings, nearly equally distributed all over the forest, were made during 1870, and since that time the forest has been successfully protected from fire and grazing of all kinds. The result, however, is not at all satisfactory, the whole area being now covered with a dense growth of grass and bushes, (principally *Indigofera heterantha* and *Desmodium tiliæfolum*), and few deodar seedlings are to be formed except those that existed at the time the forest was closed. An interesting and striking contrast can also be made between the state of the closed forest and that of a neighbouring open patch called Sunrere, situated a short distance from the Koti forest. In the latter, heavy fellings have been made by the villagers from time to time, cattle of all kinds have been allowed to graze, but no fires have apparently occurred for five or six years. The state of reproduction in this forest is most satisfactory, the whole area being thickly covered with seedlings of all ages, and it is with the greatest difficulty that the neighbouring "zemindars" prevent the trees from invading their fields. From the above remarks I hope it will not be inferred that I approve of cattle grazing in all kinds of forest in general, and deodar in particular, but only mean to point out that we have apparently commenced the treatment of deodar forests, at all events, on a wrong system, which should now be corrected.

In fact the principle that each kind of forest should be treated separately, according to its peculiar circumstances and conditions, appears to have been somewhat lost sight of in this particular instance; and forest officers seem to have forgotten the fact that one sweeping rule with regard to grazing is by no means applicable to the whole country generally. In conclusion, I have no doubt that several of your readers who have had to do with the closing of deodar forests have been occasionally slightly embarrassed by the remark of the somewhat observant "zemindar," who, after the forest officer has enlarged on the absolute necessity of excluding the village cattle from the neighbouring deodar forest, has called the sahib's attention to the fact that, notwithstanding constant

grazing and occasional fires, numerous seedlings have sprung up, and the forest probably increased in area all the same, under which circumstances he finds it difficult to believe in the sahib's scientific arrangements.

E. McA. Moir,
Dy. Consr. of Forests, Tons Divn.

Iron Smelting.

The Vienna Mining Journal (*Oesterreichische Zeitschrift für Berg und Hutten wesen*) of the 12th August contains an interesting account of successful iron smelting in Sweden by a new modification of the direct charcoal process.

The great drawback of all methods of direct iron smelting is the interruption of the process which is caused by the removal of the blooms. This has been much reduced by the following combination: A cylindrical shaft receives a continuous supply of the ore and charcoal which pass down through it. A small portion only of the fuel is consumed in the shaft, and the ore is all perfectly reduced to metallic sponge. Some red hot mixture of reduced ore and charcoal is at intervals withdrawn at the base of the shaft, and brought directly into a hearth. The air blast of the hearth, by the aid of the remaining fuel, melts the sponge into a solid bloom of wrought iron. The hearth is a closed one, so that all the time the gases from the hearth can pass into the above-mentioned shaft, and thus aid in the reduction of the ore. The withdrawal of the blooms from the hearth causes no interruption of the reduction, as it is intended to work two hearths at a time in connection with one shaft.

Whilst one hearth is separated from the shaft, the other will supply the gases, and *vice versâ*. The chief feature in the results is the almost complete extraction of the iron from the ore. The total loss of iron amounted only to 5 per cent. At the same time the consumption of fuel was moderate; 100 kilogramme of blooms required only 0·8 cubic metres of charcoal. This I take as equal to about 200 kilogrammes, which is half the quantity used by the other description of direct processes. (See my notes on the manufacture of iron, etc., in India, June 1881, page 4). More than this, the quality of the iron was found very good in spite of phosphorus being present in considerable quantity in the ores, which were magnetite, containing 60 per cent iron and 0·9 per cent phosphorus.

H. Warth.

The Chrysanthemum.

This favourite of English conservatories has, of last years, established itself in Indian gardens. We cannot as yet boast of the many beautiful varieties possessed by our countrymen at home; however a fair number of good varieties of all the principal colours are to be met with. I have been unable to trace who first introduced the Chrysanthemum into this country. Mr. Fortune was the first to send to England from China the Chusan Daisy, the plant from which the dwarf small-flowered pompons have originated. He also sent the large-flowered Japanese variety. The section known in nurserymen's catalogues as large-flowered (*Chrysanthemum sinense*) was introduced into England as early as 1764. Many hybrids have been raised between the Japanese and Chinese large-flowered varieties; and I have no doubt both originated from the same wild stock. These hybrids have found their way to this country from England,—hence Mr. Fortune may be said to be the first to credit with thanks for a plant that has done so much to beautify and enliven our gardens during one of the most flowerless periods of the year.

The cultivation of this plant is simple and easy. The climatic conditions of India will not allow us to raise the fine large specimen plants to be seen at Chrysanthemum Shows at home, but with a little trouble and care we can raise a plant that will greatly enliven the appearance of our gardens when in flower. It flowers in this country at the same time as in England, *viz.* from November to December. After the plants have flowered they ought to be cut down close to the ground, and watered as usual. About the middle or end of January the crown will begin to throw up numbers of young shoots. In England as a rule these shoots are separated from the old crowns and made into cuttings. The old crowns are generally thrown away, and the cuttings are grown into the flowering plants required for the next season. In this country, where the same method is followed, failure is the usual result. Cuttings, made from soft young shoots, do not strike root readily, and when they do succeed, the plants as a rule are weak and not able to withstand the damp of the rainy season. I find that the best method of propagation is to divide the old crowns in February, into pieces with three strong healthy young shoots attached; pot them in six-inch pots in a mixture of one part good garden soil, one part sharp river sand, and two parts old decayed leaf manure; place in a semi-exposed spot, and water regularly. The plants, if properly cared for, will attain a height of twelve to fifteen inches by the beginning of May. When they have attained that height, the shoots should be pinched back to within five or six buds from the ground. They will make very little growth during the hot season, but this is no disadvantage. As soon as

the rains set in, they will start into growth; and when well started, and after a few good showers have fallen, they should be repotted into twelve-inch pots. This time old cow or horse manure should take the place of leaf manure, there being now no danger of the manure heating and killing the plants. After the operation of potting, they will continue to grow until September. From the latter end of this month, and until the buds begin to open, a watering twice a week, with any kind of liquid manure, is very beneficial. When the buds are well formed, and if large show flowers are desired, the small side buds may be picked off, and only the large centre ones allowed to remain. If the treatment I have described be carefully followed, the resulting display of flowers will amply repay for all the labour bestowed.

W. G.

Table shewing the rate of growth of Sissoo and other trees in Cooch Behar Plantation.

No.	Description of Trees.	When planted.	Measurement up to 25th Oct. 1881.		Measurement up to 4th Sept. 1882.		Remarks.
			Length.	Girth at 4 feet from ground.	Length.	Girth at 4 feet from ground.	
1	Sissoo ...	1872-73	27—7″	2—8″	27—9″	2-10″	The maximum and minimum growth of a certain number of trees shewn.
			14—9″	3—7″	15—9″	3—9″	
			22-10″	2—6″	23	2—9″	
2	Ditto ...	1872-73	26—2″	3—8″	26—5″	3-11″	
			24-10″	2-10″	25—1″	3—0″	
3	Teak ...	1874-75	12-11″	2—9″	14—6″	2-10″	
			24—2″	2—6″	24—3″	2—9″	
			20—4″	2	20-10″	2—3″	
			6—9″	1—5″	6-11″	1—8″	
4	Sal ...	1874-74	19-10″	1—5″	20—7″	1—7″	
			10-10″	10½	11—9″	11½″	
5	Khair ...	1874-75	18—9″	1—6″	19—8″	1—7″	
			10-10″	10½″	11	1—0″	

Gobind Chunder Roy,
Superintendent of Works.

Measurement of Sal Trees in Saharanpur Botanic Garden, 1882.

THE following girth measurements have been kindly supplied by Mr. Duthie, Superintendent of the Botanic Gardens, Saharanpur, and are in continuation of those given on page 189 of our October No.:—

MONTHS.	Old Brick Hill.			Supdt's. Compound.				H. Purchase's Compound.		REMARKS.
	1	2	3	1	2	3	4	1	2	
July ...	*50⅝	46⅛	34½	64	58½	57⅛	48½	†68½	60½	*Indicates growth. † Head blown off by a storm in the beginning of July. Growth appears to have been retarded owing to the accident.
August ...	*51	*46½	*34⅝	*64½	*58½	*57½	*49	68½	*60½	
September ...	*51½	*46½	*34½	*64½	*58⅝	*58⅛	*49½	68½	*61½	
October ...	*51⅛	*46⅛	*34⅛	*64⅛	*59⅛	*58⅜	*49⅛	*68⅛	*61½	

Criticisms on Notes for a Manual of Indian Sylviculture.

I am glad to say that I have already received some criticisms on my "Notes" published in the October number of the "INDIAN FORESTER," and thank very gratefully the gentlemen, who have kindly offered them, for their early response to my appeal.

It is intended to print all such criticisms as they come in, adding whatever there may be to say in reply. Public discussion in print is the best way of arriving at the truth. The criticisms themselves will be given in italics, my remarks thereon in ordinary type.

MR. SMYTHIES.

This gentleman, being at present in England, has yet been able to see only the Definitions.

On page 102, line 7 from bottom, I would substitute the word "vegetation" for "growth." The latter might answer, but is not so good as the other. The definition would then run thus:—

"When the vegetation is composed of two or more species growing together in varying proportions, the forest is said to be mixed."

I agree and will correct accordingly.

Wherever you have employed the French word "régime" I would prefer "system." It is a pity to use foreign terms when an English one can be used with equal advantage.

Here we differ.

Now, in the first place, has Mr. Smythies never heard of the expressions "the Tory or Whig régime"? Because the obnoxious word still retains its French orthography and pro-

nunciation, is it in any respect less English than other words, whose use no one ever condemns, like "glacis," "depôt," "échelon," "chevaux-de-frise," "aide-de-camp," "détour," "fascines," "ricochet," "bouquet," patois, rampe, &c., &c.? The first part of his contention thus falls to the ground.

Then, in the next place, the word "régime" has already a distinct meaning of its own with French foresters. Employ the word by itself, and the French forester knows at once that you refer to one of the two broad methods of regenerating a forest, *viz.*, by seed or by stool-shoots, root-suckers or shoots from rhizomes. Now take the word "system." It has no such definite meaning. Put to an English-speaking forester, the question "what system do you follow in your forests?" and I defy him even to guess what you mean, unless you repeat your question in a more explicit form, thus: "Do you regenerate your forests by means of seed, or by means of stool-shoots, root-suckers, or shoots from rhizomes?" In other words the term "system" is not only meaningless to him, but you have to omit it entirely when you wish your meaning to be clear. Now ask a Frenchman how *he* would put the same question, and he will, without hesitation, and without being misunderstood, say: "*Quel régime appliquez-vous à vos forêts?*" Can there be any doubt as to which form of the question is neater, more expressive, or more perspicuous?

Why should we not then speak of the High Forest or Coppice régimes, and, by a very slight extension of the word, employ "régime" by itself in an abstract sense, as the French already do, and as we have done in our "Notes"? When we already possess a truly English word, although appropriated bodily from the French, which can express all we wish to say, why should we adopt another word, in no respect more English, that has never been used in the required sense since it was borrowed from the same foreign language?

Similarly, the word "coupe" labours under the same disadvantage of being of foreign extraction, and yet I cannot say that I can suggest any one English word that would be a complete substitute. Periphrases, varying with the requirements of the sentence in any particular case, ought to answer, and would not only read better, but be more acceptable to English-speaking foresters.

I used to be of the same opinion as Mr. Smythies, but experience, and the necessity of expressing my ideas briefly and yet clearly to the students, has convinced me that it is best to stick to the old word "coupe," which has been already used in the first (Indian) edition of Mr. Smythies' and my translation of Bagneris's *Manuel de Sylviculture*. To enter into a full discussion with the object of justifying my present position in respect of the word would lead me too far: I should have to write a short treatise embodying most of the principles of forestry. When we have completed the Rough Draft of Vol. II

of our Manual of Indian Sylviculture, our critics will be able to decide on the merits of the word considered from every point of view.

Page 106, *line* 11 *from top, the word "fall" is American and signifies autumn.*

But this signification of the word is also English. Besides Mr. Smythies will find that the word also means "that which falls, *i.e.* anything fallen." At least one English writer (I think it is Ablett) uses it in the sense in which I have employed it. No one will contend that it is not extremely convenient to possess a single word meaning "the produce obtained from a felling."

Page 103, *lines* 3 to 5 *from bottom. I would re-arrange your definition of a seedling thus :—*

"*A young plant, which results directly from the germination of a seed is called a* SEEDLING, *and it retains this name until it begins to lose its lower branches.*"

I am much indebted to Mr. Smythies for this very necessary correction.

Page 105, *line* 22, *from top. Don't you think this line ought to run as follows?*

"*The* PRINCIPAL *species (there may be one or more) is that, &c.*"

Quite so.

Page 106, *line* 10 *from bottom.* "*Shade-avoiding*" *is a capital word. It has a true Homeric ring about it.*

I of course agree, but Major Van Someren does not. I have answered the Major's objections a few pages further on.

Page 106, *lines* 1 *and* 2 *from bottom, and page* 107, *line* 1 *from top.* "Accordingly the cover of a tree means the action exercised by its crown within the space below included in its vertical projection." *This sentence does not read well.*

I think so too, and would cut it out altogether, and after line 3, on page 107, would insert the following :—

"A plant is said to be SUPPRESSED or UNDER SUPPRESSION when its growth has been injuriously affected by cover; and, conversely, one plant is said to SUPPRESS another when it affects injuriously the growth of the latter by its cover.

Your definitions are very carefully drawn up, and there is very little to add or remark thereon. I congratulate you accordingly.

Thank you, Mr. Smythies.

MAJOR VAN SOMEREN.

Page 103: *I would suggest that, when printing your Manual, the word* "*crop*" *in lines* 15 *and* 17 *from bottom of page, be printed in capitals. You are writing of* REGULAR *and* IRREGULAR CROPS, *as just below you write properly of* "REGULAR FOREST," *not of* "REGULAR *forest.*"

This correction has been noted.

Page 104, *line* 10 *from bottom: I think "to top" a plant is better English, and quite as expressive and as intelligible as "to top off."*

I am not disposed to agree *in toto* with Major Van Someren, but will be glad to drop the superfluous "off."

Page 104, *lines seven and eight from bottom: "Exploit" and "Exploitation" are not words which will ever take. They don't fit into English anywhere, and they have not the legitimate birth of a word like "epicorm," which is clear, though direct from the Greek. This term takes its place as filling a want. I acknowledge the want of a good word in English forestry for "exploit," but that is not the word to fill the gap. On page* 106, *you use "to clean fell" a coupe, that is to work out that coupe or "to fell it in accordance with the principles of sylviculture, as you write on page* 104 *of "a forest or crop." Why not use "to work" and "working out" a crop or forest, instead of "exploit" and "exploitation?" "To work" or "work out" a forest or crop would never be confounded with the method of raising or improving it, that is "the method of treatment" or "treatment" of the forest or crop. "Work out" is, I think, the best term.*

I don't object to exploit merely as a French term, for "coupe" is a good word to import into our glossary. Again, I don't think "exploit" and "exploitation" can fairly be placed in the list of words "that have received the sanction of foresters working in every part of the world where English is spoken," "as you say on page 100, *second paragraph. Is it a fact that it is used in America, Canada, Australia, or even India?*

First, I must point out a misapprehension on the part of Major Van Someren of my definition of the verb "to clean fell." The misapprehension is perhaps due to that definition not being clear enough. What I meant to say was that the idea of "a clean felling" implied the removal, *in a single operation*, of the entire standing crop. I will not fail, in order to secure myself against any further misunderstanding, to insert the italicised words, when my rough draft is printed.

Before I proceed to consider the terms suggested by Major Van Someren, it will be well to explain why I adopted the word "to exploit" and the corresponding noun "exploitation."

There is no doubt that we require some term to distinguish the felling, gradual or wholesale, as the case may be, according to scientific principles, from the mere mechanical operation of felling. A forest, in which the trees are removed without any reference whatsoever to its favorable growth or regeneration, in which the people drawing their supplies from it cut how and whatever they please, with the sole object of satisfying their immediate wants, such a forest, I say, is placed under very different circumstances from one, in which only such trees are felled, as, in the opinion of an expert, can be spared consistently with the good growth, improvement, and maintenance of

the forest. The word "to work" suggested itself, but it is obvious that to work a forest connotes something more than merely felling it in accordance with the principles of sylviculture. To *work* a forest is not only to fell the trees according to correct rules, but also to intersect it with roads, slides, &c., by which the produce felled may be exported, to render the forest accessible to all the possible markets, and to do a great many other things besides. What term was I then to adopt? The French use the word "*exploiter*" in the sense of both "to work" and "to fell according to correct principles." We are creating a new terminology, and, therefore, having the opportunity, it is incumbent on us to avoid all ambiguity that we can help. Having already the word "to work" to express the one sense, why could we not adopt the French word (modified of course to suit our idiom) for the other? I was aware that the verbal noun *exploitation* had already been completely naturalised by miners. What objection was there to importing the same word into our forest terminology? Surely none. The next step was simple enough. Every verbal noun presupposes a verb; we must, therefore, get our verb. What is more obvious than adopting "to exploit," a form already thoroughly English, although used in a different sense? Here then we have the verb "to exploit" and its noun "exploitation" in the most natural manner imaginable.

But there were still other reasons for adopting those words. When a forest, or crop, or tree, has attained the maximum of utility for its proprietor, and may, therefore, be felled with the greatest advantage, what qualifying adjective shall we use to designate the possession of this quality? And what noun this quality itself? The verb "to exploit" lends itself completely to our purpose. We derive at once the adjective "exploitable," and the noun "exploitability." In place of these two words the terms "mature" and "maturity" have been suggested. But the expression "a mature tree" gives one the idea of a tree that has reached the period of its decline, *i.e.*, and cannot grow any further without decaying, or at least languishing; whereas a crop or tree may have to be felled long before it has attained that advanced age, as for instance, when the maximum quantity of produce per acre per annum is required from the soil, or when the highest percentage of profits calculated on the money value represented by the soil and the standing forest is demanded.

Thus we have the terms "to exploit," "exploitation," "exploitable," and "exploitability" following one another in logical sequence. Even the Germans, who have their *hauen*, *hauung*, *haubar*, and *haubarkeit*, must acknowledge the superior expressiveness of our terms as well as their more special appropriateness. "Exploitable" and "exploitability" are terms representing ideas that belong exclusively to the art of organising forests, not to sylviculture, which is the art of growing forests.

I will now consider Major Van Someren's remarks.

He says that "to exploit," and "exploitation," are words that "don't fit into English anywhere," that is I presume, that they are not English in form and sound. But I have already shown that they exist in the language, and were used by educated Englishmen (if in other senses, does not concern the question at issue) before I perceived their peculiar fitness for the ideas I wanted to express. "Is it a fact," he asks, "that it is used in American, Canada, Australia, or even in India?" Here I must say he puts the cart before the horse. In my introductory remarks on page 99—100 I said:—

"Forestry in India is an art of very recent growth, while in the United Kingdom there is not only no uniform set of technical terms in general use, but, moreover, owing to the fact that forest management on a large scale has, for obvious reasons, never yet formed an essential part of the state economy, several important ideas, which, to the continental forester are every-day commonplaces, have not received their expression except in seldom-used, clumsy periphrases. In drawing up my vocabulary I have hence considered myself completely unfettered by present practice, save in so far that I have felt myself bound to accept current words that are logical equivalents of the ideas for which they stand." (Major Van Someren has evidently forgotten these sentences which I have been obliged to repeat here).

And then I added that we must, in order to carry on the instruction at the Forest School, while the Manual was still under preparation, "have a complete set of technical terms that have received the sanction of foresters working in every part of the world where English is spoken." Hence, to ask me to produce authorities from the United States, Canada, Australia, and India for every word, which (and this point must not be forgotten) I have *tentatively* used in the Notes subject to future correction, is beside the point.

Nevertheless I may mention that the word "exploitation" has already been used in India by, if I mistake not, Mr. Baden-Powell, no mean authority; and also in the translations of two French works on forestry. Moreover, one of these books (Bagneris's Manual of Sylviculture by Mr. Smythies and myself) has been used as a text-book at the Royal Agricultural College at Cirencester in England, and a second edition of it has just been brought out in England by Messrs. William Rider and Son, the well-known Publishers of the *Journal of Forestry*. The other work has been reviewed in the journal just named, which commended the terminology used. I may add that in this last book the words "exploitable" and "exploitability" have also been employed.

I would, *en passant*, once for all beg readers of the Notes to remember that the *scientific treatment* of large forest estates—

estates measured not by tens but hundreds and thousands of square miles—is only now in its inception in the countries of the world where English is spoken; and that we have still to invent words for ideas that are either quite new to us, or for which, from their recurring only seldom, longer or shorter periphrases have hitherto sufficed. Without assuming too much, I may say that this is the first general attempt made to invent a complete English terminology. And what we want now is a critical examination by the whole body of English-speaking foresters of the terms I propose for adoption, the rejection of those for which more suitable equivalents already exist, and the final acceptance of the rest.

Major Van Someren suggests "to work" or "to work out" instead of "to exploit," and he has a preference for the second term. I have already shown why the first one will *not* do. "To work out" has no better argument in its favour; it necessarily involves the idea of exhaustion—an idea wholly incompatible with the scientific treatment of forests.

If I have not made out a good case for the terms "to exploit' and "exploitation," I have, I flatter myself, at least demonstrated that Major Van Someren's objections thereto are unfounded, and that the words he would adopt in their place cannot be accepted.

On page 106, *line* 10 *from bottom, is not "light-loving" better than "shade-avoiding"? And in line* 13 *from bottom, "shade-bearing" requires a mental twist to catch the meaning you attach to it. A "fruit-bearing tree" is not a tree which can maintain itself with fruit over it. "Shade-suffering" would be better English and more intelligible than "shade-bearing"; but "shade-loving" would I think be best.*

On page 118 *you write of "shade-bearing trees." Reading lines* 18, 19, 20, *to end of para., the forced meaning you attach to "shade-bearing" seems to me very awkward.*

Major Van Someren has evidently forgotten that the verb "to bear" means not only to bring *forth*, but also *to endure, to suffer*, the one sense being at least as common as the other; so that his analogy of a "fruit-bearing" tree does not apply.

The term "shade-loving," which Major Van Someren proposes, I myself adopted at the outset. But it would have perpetuated an error, which is invariably committed by French foresters, and which even some German foresters, from old unforgotten habit, unwittingly fall into. "Shade" is the opposite of "light," and there is no tree, shrub, or undershrub which does not require light for its very existence. To love shade is the same thing as to avoid light. To say that a tree is shade-loving is thus to contradict nature herself, whose humble servitors we are. Similarly, to say that a tree is light-loving, is to predicate of it a quality which is common to it with all other trees, although it may be in different degrees. Hence it is obvious that the distinction that

we have to mark is this, *viz.*, whether a plant can live under shade or not. Of course all plants can stand a certain degree of shade, but that does not affect my argument, as we simply require to divide our forest plants into two broad classes—(*i*) those capable of living under more or less dense shade; and (*ii*) those which shade continued for a comparatively short time, without at least occasional direct insolation, would kill. For the first I have adopted the term "shade-bearing," for the second "shade-avoiding."

I confess I gave up our old loves "shade-loving" and "light-loving" not without a keen pang of regret. There was a certain poetical ring about them that won the heart. But I felt it my duty to sacrifice all personal likes and dislikes for the sake of truth.

It requires only a few words to explain the origin of the old error, still so fondly clung to, which has been perpetuated in the term "shade-loving." There are a number of plants which are very sensitive to frost or drought, and which require the shelter of trees that overtop and overhang them. Such plants (naturally so) can also live under shade. The popular voice immediately termed such plants shade-loving, and by going a point further, assumed that all plants that can live under shade enter into this category. But, unfortunately for this hasty generalisation, Nature has furnished us with the *Mesua ferrea*, *Hardwickia binata*, mulberry, and a great many other trees, which, while even the densest cover cannot kill them, nevertheless thrive in the complete open. I would then ask the advocates of the time-honoured terms, which are now given up, whether such trees are "light-loving" or "shade-loving." According to their way of looking at things, they are *both!* Evidently a *reductio ad absurdum*.

The fact is that we must distinguish between the ability of a plant to live in diffused light (shade), and its requiring shelter against frost or heat; or both. This I have done in the Notes, and thus we have shade-bearing with its opposite "shade-avoiding" on the one side, and "delicate" with its opposite "hardy" on the other, according as we consider plants from the standpoint of direct and diffused sunlight, or of shelter and its absence.

Major Van Someren suggests "shade-suffering" as an alternative to "shade-bearing." But I prefer to retain the latter, and to leave unfettered the employment of the verb "to suffer" in the sense of "to be injured." For instance, I should like always to be able to say that, "although a certain plant is extremely *shade-bearing*, it is nevertheless *suffering* from too dense a leaf-canopy overhead."

In adopting the terms Major Van Someren objects to, I have received the unqualified support of many experienced foresters, Englishmen by birth and education. I confess I

do not see what "mental twist" is required to apprehend the meaning I have given to the term "shade-bearing."

Referring to the definitions generally, Major Van Someren writes: "*You invite criticism, but I think you are to be complimented for the large number of good terms you have put together.*" I thank the Major for his kind appreciation.

You write about Pinus longifolia and deodar on page 118 *following on your remarks in last part of page* 117. *It is very striking at Simla to note how deodar everywhere shoots up under heavy shade, and it is not so beaten by silver fir as you state broadly on page* 118. *But this is only one place, and, while not contesting your position seriously, I think it well to note this for you. In the Murree hills, the blue pine is spreading fast and taking the place of P. longifolia. I have asked Elliott to make careful notes of this, and to write you some time hence about it.*

The preceding observations of Major Van Someren's are very interesting. Regarding the silver fir and the deodar I meant only to say in a general manner that on damp, cold aspects, at high elevations, the former would prevail over the latter. I would invite the Major kindly to read over again my remarks on ASPECT and ALTITUDE on pp. 123-124, and inform us whether the places where he says deodar "is not so beaten by silver fir," are not too low for the aspects in question to be cold and damp enough to give the former species all the advantages which it possesses in the heart of its habitat.

I shall expect Mr. Elliott's notes with great interest, and trust he will dilate on the struggle for existence between the *Pinus longifolia* and the *P. excelsa* as much as possible, examining every feature of this important struggle.

W. R. F.

Page 108, line 10, from top. *The Eugenia Jambolana is an evergreen except in drier places, and is mentioned by Brandis as one of the principal species of the evergreen forest of the Ghats. Several other Eugenias in Assam are also evergreen.*

As far as I have been able to judge, the leaves of the *Eugenia Jambolana*, *E. caryophyllæfolia*, and *E. salicifolia* do not persist for a whole twelvemonth; hence they are not evergreen trees. *Eugenia operculata* is unquestionably not evergreen. It would be very useful if this matter were cleared up once for all. A mere assertion that such and such a species is evergreen will not suffice; the writer must be able to state that he *certainly* noted leaves on the trees that had persisted during at least a twelvemonth.

Page 108, line 11, from top. *Sissoo in the Dehra Dun is quite leafless for several weeks.*

I have been marching for the past fortnight through this Dun, and have come across many sissoo trees with their old leaves still on, and the new ones just coming out.

Page 120, line 14-19, from top. *In the North-Eastern Provinces of India, other companions of sal, which attain the same height as that tree, are Schima Wallichii in damper places and on hills, and Lagerstræmia parviflora and Dillenia pentagyna.*

This information is very interesting.

"Sw."

SINCE going to press I have received some excellent criticisms from "Sw.," which are given at once in order to relieve the pressure that is sure to arise for space in the following January Number, the first of the new monthly series. There is thus no time to interpolate my own replies, as I have done in the case of other critics; and accordingly "Sw.'s" paper is printed *en bloc*, and my replies will be published in the next issue. For the sake of easy reference, when making those replies, I have divided "Sw.'s" remarks into sections distinguished by characteristic letters of the alphabet.

"Sw." suggests that, in order to show at a glance what portions of his paper are extracts from the Notes, and which form his criticism, the former should be printed in italics, and the latter in ordinary type. I would very gladly have had this done, but for the plan which has been laid down in the second paragraph of this article, and which I have hitherto followed, I have no alternative but to have the whole of "Sw.'s" paper printed in italics, however repulsive that may appear to the eye.

In the October Number, 1882, of the "Indian Forester" a part of the proposed "Manual on Indian Sylviculture" has been published, and criticisms invited. Assuming that not a complete criticism of the whole part published is expected, and that it is permitted to any of your readers to take up such points as they may choose, the following remarks are offered:—

PRELIMINARY DEFINITIONS.

(*A*) "*A tree is any woody plant branching from a certain height above the ground, and capable of attaining a minimum height of 25 feet.*"

"*A shrub is a woody plant incapable of attaining a greater height than 25 feet, and which branches at or near the base.*"

Why, it may be asked, exactly 25 feet? Why not 24, or 15, or 50? Surely to fix the minimum height at 25 feet is a most arbitrary proceeding which has nothing whatever to do with the character of a tree. The important point is, that it carries up a single stem for some distance from the ground, and then begins to branch, while a shrub branches at once at or near the ground. This should be sufficient. Whatever minimum height might be fixed upon, no logical mind would admit such a condition as an essential part of a tree.

(*B.*) "*Middle sized trees, between 50 and 80 feet, e.g. Quercus semecarpifolia, Toon.*"

Q. semecarpifolia grows to upwards of 100 *feet high in Nepal. Toon in Darjeeling grows into an enormous tree, a specimen having been measured which contained* 600 *cubic feet of timber, and was considerably more than* 100 *feet high*

(C.) "*The length of the stem of a tree under its branches is called its bole.*"

Hitherto it has always been understood that the bole of a tree means its stem above ground without the branches, generally as high up as it may be fit for timber.

Where does the bole end, if the tree has branches close down to the ground, as will often happen? What is now described as the bole has hitherto been understood under "clear bole."

(D.) "*A coupe is any area in which a felling has been or is to be made, and the produce obtained from the felling is collectively called the "Fall."*

The word "Fall" seems awkward. Would not "Yield" be more appropriate and natural?

(E.) "*When a coupe is not clear felled, the trees left standing are collectively termed the Reserve.*"

The word RESERVE *is in this case highly objectionable, as Indian foresters are now accustomed ,to understand something quite different under Reserve. It would be much better to substitute the word "Standard," which is well understood.*

(F.)..."*Trees which can only live in more or less direct sunlight are said to be shade-avoiding.*"

*Why not call them "*LIGHT DEMANDING.*" They really demand light, rather than avoid shade.*

CHAPTER II.—*Struggle for Existence.*

FIRST CASE.

(G) I.—RELATIVE INNATE VIGOUR.—"*Stool-shoots are much larger and stronger than, and easily suppress seedlings of their own age.*"

This is no doubt correct, but it may mislead the beginner. The wording might be altered to the following :—"Stool-shoots are, up to a certain age, much larger and stronger than seedlings of their own age, which they easily suppress during that period. Later on in life seedlings overtop stool-shoots."

(H) IV.—DENSITY OF LEAF-CANOPY.—"*If the species composing the crop is shade-bearing, like the deodar, silver fir,... ..*"

Deodar and silver fir should not be put side by side in this manner, as the silver fir bears a great deal more shade than deodar.

(I) ....."*and both abhorring the interlacing of branches.*"

The hypothesis of trees abhorring the interlacing of branches is of a very doubtful nature, and the less said about it the better!

SECOND CASE.

(J). X.—DENSITY OF THE LEAF CANOPY....."*in the case of trees that are very partial to light, like ...* Pinus longifolia, *sal....*"

Sal is here described as very partial to light, like Pinus longifolia, *but on page* 106 *it is put down as shade-bearing, e.g. .....sal, silver fir. ..... Surely it is quite out of the question to classify it on one occasion with chir one of the most light demanding trees, and on the other with silver fir, one of the most shade-bearing trees.*

THIRD CASE.

(K). II.—GREATER SUITABILITY OF SOIL AND SUBSOIL... "*The Sissoo alone can grow on the alluvial shingly banks and beds of some rivers.*".....

The Khair does the same, and in fact it is often found mixed with sissoo in such localities.

(L). III*a*.—ATTACKS OF INSECTS AND OTHER ANIMALS.—*Under this section the intervention of "man" is treated. Is man included amongst "insects" or amongst "other animals?" Surely he should have been considered worthy of a separate sub-head!*

E. E. FERNANDEZ.

Bamboo for Paper Stock.

TO THE EDITOR OF THE "INDIAN FORESTER."

SIR.—I have just received, through a friend, your Journal for July, containing "S. E. P.'s" (Mr. Peal's) letter complaining of what he terms my unjust attack upon him: Verily "those who have greenhouses should not throw stones;" and surely my rejoinder to his criticism on my remarks at the Society of Arts Meeting, viz., "*that not one single statement there made was accurate even approximately,*" was both *just* and *justifiable.*

"S. E. P." says I make no distinction between stems and clumps. I do not see how he can assume this from my remarks at the said meeting, and I think if he will read my letter again, to which he refers, he will find this assertion not justified: commenting on his renewed criticisms in order as written:—

1*stly.*—I did not state that a full-sized bamboo stem ever grew from a seed, or that bamboos were artificially propagated by or from seed. I said that in *natural* propagation the young bamboos sprang from the seed of the old plant, and then went on gradually maturing; finally, like their predecessors, seeding and dying.

2*ndly.*—If, as "S. E. P." asserts, "the stems are mature, and often die before 15 years," I can only say I was not aware of the fact, and imagined the stems thrown up annually every season grew and went on maturing with the parent stool or clump, dying only when it died. My ignorance of this (so-called) fact arises from my attention having been given chiefly to young or season's growth, the stems of which I find are not silicious, only becoming so as they mature by age.

Maturity, by the way as I understand the word, does not mean death, as a man is not considered of mature age till 45 or 50, though living till 70 or 80; or more capable of producing children as the bamboo clump or root does young stems after maturity.

3rdly.—As to the insides of stems gradually filling up, I must admit that my remarks, as reported at the Society Arts Meeting, point to that conclusion. I referred, however, more especially to the conducting sap vessels becoming gradually ossified, the thickness of the Annulus of the stems thrown up as the clump matures increasing, the outer portion thereof becoming more and more silicious or silicified and hardened by age, that is every succeeding year.

4thly.—An individual stem never seeds by itself; in this I agree, believing that all, or nearly all, the stems of a clump seed simultaneously.

"S. E. P." says "that whether bamboos are propagated naturally or artificially (I assume he means only the latter) by the young or two-year-old stems or offsets, propagating power is *crippled.*" *Literally* this may be correct, but as only a very small proportion of young two-year-old stems would be required, and then only if forming a "Baries," and as I do not propose to use two-year-old but only season stems, the crippling would be really infinitesimal, especially as the annual or season cropping should not exceed one-half or two-thirds of the stems thrown up. The sugarcane is propagated by cuttings, but the sugar crop is not affected thereby.

I will not attempt to remark on "S. E. P.'s" list of bamboos under their native names. I might as well deluge "S. E. P." with the technical details of paper making, of which I fancy he may know as much as I do about Assamese bamboos. I can only broadly state that I have found young season shoots, cropped from matured clumps, make excellent paper stock; and I must leave Mr. Peale and others interested in the supply of such stems to solve the problems of their cropping, cultivation, and propagation, only adding that I trust this and further discussion may enlighten all interested in the question of new sources of supply of paper-making material which is becoming more and more urgent.

There appears to be a singular parallel between the growth or propagation from seed of bamboos and Esparto grass. It is said that Esparto takes from 10 to 15 years to form the mature atocha or root-stool, in the same manner as clumps of bamboos form. The Esparto can be propagated by offsets from the root-stool, and too much cropping or plucking weakens the parent plant as does too much cutting the bamboo; but as propagation of the bamboo is so readily produced either from offsets or cuttings of the stem, I am hopeful, ere long, to learn that attempts at least have been made to thus extend our much-desired supply of paper stock.

In conclusion with "S. E. P." I only believe in controversy as a means of developing truth, and in that sense am glad of "S. E. P.'s" criticisms. I now hope "we may quietly compare notes" such as may be instrumental in furthering the enterprise I have at heart, *viz.* to draw our supplies of paper-making material from India.

If bamboo cannot be readily and economically propagated and cultivated for paper-stock, the sooner the question is decided the better. It is assumed, and has been asserted, that bamboos of the varieties suited for paper-stock, that is long-jointed succulent stems, such as the *Bambusa Brandisii B. polymorpha, B. tulda, Dendrocalamus Hamiltonii* &c., will not grow otherwise than in large clumps, therefore occupying much space with small yield of season stems to the acre; and that such clumps cannot be regularly cropped without injuriously affecting the continuity of growth. The question to determine is whether this is really the fact; or whether, as I hope and believe, by systematic cultivation and cropping the bamboo can be made to produce a denser growth or better yield to the area under such cultivation. Further investigation and experiment on this crucial point is much to be desired, and in this I ask "S. E. P." and others to cooperate.

CLAXHEUGH, SUNDERLAND, 11*th September* 1882. THOMAS ROUTLEDGE.

Weight of Deodar Seed.

BEING fond of statistics, besides believing that they are most useful in cheapening work, I send some particulars about deodar seed, which may be useful to brother officers who have to collect it. I am doing so now; and when the coolies first began to extract the seed from the cones, I found they were sitting in the warm sunshine, picking each seed out with the finger and thumb. I speedily knocked that on the head, and made them take baskets and shake the cones, previously broken up, in them, the consequence being that the seed dropped through, and they are able to clean about six times the quantity. I then took out of a heap eight ordinary cones, and myself carefully picked out all the good seed, counted, and weighed them with a letter scale very carefully with the following results:—

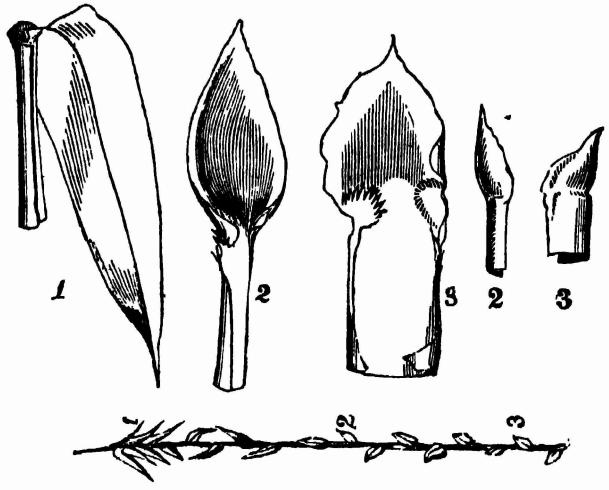
The eight cones gave 613 good seeds, which weighed 3 $^{9}/_{16}$ oz. As the coolies were then bringing in their kilta loads of cones from the forest, I counted the contents and found the average per kilta to be 150 cones. Taking the above figures 18 kiltas should give 82lbs (one maund) of cleaned seed. When the trees are near at hand a man can bring in two kilta loads per day, or 300 cones, which should give 8½lbs of cleaned seed, so that

ten men can bring in (roughly) one maund of cleaned seed. To the cost of this has to be added the extraction of the seed from cones. I have not yet got accurate figures, but, as far as I have gone, it would appear that one man can only take out 4lbs. of cleaned seed per day. Working all this out it will be seen that the cost of collecting one maund of good cleaned deodar seed should be between Rs. 6 and Rs. 10.

J. C. McDONELL.

Bamboo Spathes.

TO THE EDITOR OF THE "INDIAN FORESTER."



SIR,—Regarding the collection of leaves or spathes of our bamboos, I once started collecting for Mr. Kurz, but found a serious difficulty *re* the spathes at the very commencement, *i.e.*, they often differ more conspicuously in form on the one single stem than in different species. Thus the spathes of our jati below on the young stem shoot are as in 3, while those at say three-fourth of the way up are much longer, as in 2, and those at the summit as in 1, are so very like ordinary leaves, that if it were not for the lower part one would take them for leaves. In the plate above they are shown on the culm and opened out.

Query is, which is the type?

Perhaps you can say if the lower ones only or mid stem are taken, they all have very decided differences. Perhaps those about X would be best.

I cannot find anyone who knows of any of these játis in flower. But natives do not, as a rule, observe very closely unless there is some special reason, and then they often beat us as in telling the various kinds of paddy, &c.

S. E. PEAL.

Investigations of Forest Cases by Forest Officers.

Section 71 (*d*) of the Forest Act empowers the local government to invest forest officers with the power to hold enquiries into forest cases; and in the course of such enquiries to receive and record evidence. But nothing is said about the procedure to be followed, nor is it stated that the forest officer, when holding such enquiries, can compel the accused to attend, or the witnesses to give evidence, or take the oath if they decline to do so. Thus the section as it stands amounts to this: The local government may empower a forest officer to hold enquiry; but any person accused of a forest offence may cancel this authority in his own particular case if he chooses to do so.

I have recently held a number of enquiries under this section, and, for want of a better, have adopted the following procedure, which, I am told, is not illegal.

On receipt of sufficient information regarding a forest offence to enable me to act, I summon the witnesses to appear and give evidence under section 71 (*b*), using, of course, a civil summons form, as this section only gives the powers of a Civil Court to compel the attendance of witnesses; and, as no power is given with regard to an accused, I simply *issue a notice* to him that the case, which is briefly stated in the notice, will be investigated under section 71 (*d*) of the Forest Act on a date specified. If the accused declines to attend, the investigation breaks down, and (unless there is sufficient evidence to warrant the arrest of the accused under section 63), all that can be done is to take the statements of the witnesses and forward them, *as statements*, (not as sworn evidence) with a report of the case to the Magistrate having jurisdiction in the matter.

But if, as generally happens, the accused and the witnesses attend on the day appointed, I investigate the case after the procedure prescribed in the Criminal Procedure Code for the trial of summons cases. When the investigation is ended, if it does not appear that the accused is innocent of the offence with which he was charged, I forward the evidence taken, and the statement of the accused, together with a short report of the case, to the Magistrate of the district in which the offence was committed, and I call on the accused to give security for his appearance before this Magistrate on a stated date, generally the next day on which the Court is open. If he cannot give security, and the offence is such as to warrant his arrest under section 63, and requires such extreme measures, I send him

before the Magistrate under arrest. If not, or if the offence does not admit of this, he is let go, and it is left to the Magistrate to compel his attendance as in other criminal cases.

This procedure has hitherto answered because everything goes on smoothly, and the witnesses and accused have appeared when called, and answered any questions put to them. But if they had not chosen to do so, the powers of Section 71 (*d*) would have been perfectly useless.

There is another point with regard to this section which has somewhat surprised me, namely, that forest officers, empowered under it, are not obliged to keep a register or record of the investigations held by them. This is all the more necessary because the documents relating to such cases are, in most cases, forwarded in original to the Magistrate of the district; and when (as not unfrequently happens) a question relating to such cases already disposed of arises, the records have to be got back from the Court or Office, they have been sent to; and this is often inconvenient and always a source of delay. I have frequently had a number of forest cases pending at the same time, and I have found it necessary to keep such a register *for my own information* in the following form :—

(Specimen of Register of Forest Cases.)

Original Report.			Investigation by Forest Officer.		Prosecution or final disposal.				
Serial Number in Register.	Date of receipt of report.	Name of informer Names and residences of accused and witnesses. Nature of offence. Locality where committed.	Dates of order by Divisional Officer	Order by Divisional Officer. Summary of information collected.	Date of disposal	Rule infringed	Final order disposing of case.	Number prosecuted.	Number convicted.
55	1-12-81	Titta Dimoroo mouzadar, reports that he saw five ajhar logs in possession of Debendronath of Titta Dimoroo, who was removing them from the Kukurajoojoah Forest without a pass. Titta Dimoroo Mundell and guard Hombor saw him.	1-12-81 3-12-81 3-12-81 6-12-81 8-2-81	To Ram Charan Forester to report and to seize timber if statement correct Ram Charan reports statement of mouzadar correct, but timber had been removed Witnesses named summoned to appear on 6th instant, notice to accused accordingly. Ban Charam ordered to endeavour to trace timber. Timber traced to Dibrughur, and seized under Sec 52. Records forwarded to Deputy Commissioner with Memorandum No. $\frac{S}{225}$ of 7th February 1882. Hearing of case fixed for 13th instant, *vide* Deputy Commissioner's Memorandum $\frac{J}{620}$ of 8th February 1882 Ram Charan to attend and prosecute.	13-12-81	Sec. 13 of Rules of 1876.	Debendronath fined Rs. 20; timber made over to keeping of District Forest Officer.	1	1
56	6-2-82	Forester Mungla Das reports coolies of Honkong Factory, Mr. Jones proprietor, had made 800 maunds of charcoal near boundary of his grant No. 54. in Makum District Forest.	7-2-82 10-2-82	Notice sent to Mr Jones that case will be investigated on 10th instant Mr. Jones attended and stated coolies has mistaken boundary of his private land, and offered to pay amount due.	10-2-82	Sec. 8 Rules of 1877	Royalty on charcoal Rs 100 accepted under Sec. 67 of Forest Act.	Nil.	Nil.

This form of register may be considered too detailed, but I have not found it so in practice. In addition to this register I have found it necessary to keep, on a separate page of the same book, a register regarding timber seized under section 52, and of confiscated timber left in charge of the forest officers under section 55 :—

(*Specimen Register of attached property.*)

No. of case in Register.	Date of Seizure.	Description of property.	How marked by officer making seizure	Where kept.	Name of Subordinate placed in charge.	Date of order.	Final disposal Substance of order.
49	2-12-81	One sam boat. 45ft. × 8ft.	F D	Toll station	F o rester in charge of Toll Station.	6-2-82	Confiscated. Deputy Commissioner's order No. 1292, dated 22nd December 1882. Sold by public auction for Rs. 320.
55	6-12-81	5 ajhar logs 10′×4′ 10′×4′ 15′×4½′ 14′+4½′ 18′+4½′	F. D.	Forest at corner of the Mohanbarie Road.	"Hombor" forest guard.	13-12-82	Divisional Officer ordered to take charge of timber. Deputy Commissioner's memo. No. R. 628.
						26-2-82	Timbef sold by public auction, *vide* item No. 26, cash book for February.

I would be glad to know if any orders or rules have been published on the above subject in other Provinces.

JUNGLI SAHIB.

The above has been referred to Mr. Baden-Powell, C.S., for legal opinion, and his remarks follow :—

"The power to obtain witnesses by Civil Court process does not refer to witnesses for the offence, investigation (*d*), but to the preceding power of survey, &c., and is with a view to ascertaining boundaries, owners of adjacent lands, &c., &c.

"In the Central Provinces the divisions are very large, and the population very scanty; it must often happen then that either offences would go unpunished, or the greatest difficulty be experienced in sending a prisoner forty miles or more over roadless country, so that the officer is invested with magisterial powers where he has *all* the needed powers for hearing the case.

"It was *never* intended that in *every* forest case the forest officer should make an investigation, though every higher grade officer may reasonably have the *power to do so.* The only object of the section is to introduce tentatively, and as far as it will go, something *like* the French plan of *procès verbal*, and the only cases in which it should be resorted to, is (1) to "constater" (formally record) a certain condition of things which the forest officer sees himself, the accused being with him (caught in the act, or arrested for it under the powers given by the Act), and when either the officers himself, the guards, &c., with him, or people on the spot are witnesses.

"(2.) It is also useful to record and preserve evidence of facts likely to disappear from lapse of time, weather, &c. In not one of the cases in Jungli Sahib's register does the investigation seem to be necessary at all; either such cases should be complained of to the Magistrate direct; or if the forest officer is so situated that it would be difficult to prosecute owing to distance, then the matter should be brought to the notice of the authorities, so that at last the magisterial authority may be provided within reasonable reach.

"No power exists to take security or anything of the kind, or to issue notice to the accused.

"The power can only be used in necessary cases, not always, when the accused is caught on the spot and arrested, and with the aid of such witnesses who, as before remarked, are on the spot."

Analysis of Wood Ashes made by Students at Forest School.

THE following table contains the analysis of wood ashes made in the Central Forest School at Dehra Dun, from July to October 1882.

The quantities all refer to steam dried wood. At the end of the table will be found the weight of air dried wood, which corresponds with 100lbs. of the steam dried wood. With the exception of the maljhan creeper, the wild palm, and the bamboo, all the woods were carefully cleared of their bark before they were analysed.

The total quantity of ash in 100 parts of wood varies from 0·14 to 11·74. Conifers have comparatively the smallest proportion of ashes. Deciduous trees have generally more ash, but just the most precious timber trees amongst them Sal and teak are again the poorest.

The amount of soluble salts (potassium compounds, including

more or less sodium compounds) varies as much as the total quantity of ashes, and inferior wood, such as that of pial and maljhan have large quantities. The soluble salts were extracted by means of water, the solution evaporated and the residue weighed. The proportion of carbonate, chloride, and sulphate was estimated from the respective precipitates. Sometimes the soluble salts are mostly carbonate; at other times the carbonate is far the smaller in quantity.

The salts were mostly potassium compounds as shown by the flame reaction, but in three cases there was a yellow flame, and, therefore, more than traces of sodium present. The quantity of insoluble phosphates is generally about double that of the soluble salts. Here, again, the more precious timber trees contain rather less phosphates than some inferior trees. The phosphates were examined in five cases, *viz.*, 1, 9, 11, 14 & 15, and found to consist of a small quantity of iron and aluminium phosphates, and of a larger quantity of calcium and magnesium phosphates.

Calcium carbonate formed generally the largest amount of the ashes. Magnesium carbonate often approached, and in two cases even exceeded the calcium carbonate. It should be stated that the weights of these substances were, as a rule, only estimated; but the total weight of matter soluble in acids (comprising all the phosphates, calcium carbonate, and magnesium carbonate) was ascertained as the balance of weighings.

The matter insoluble in acids rose high in the cases of palm and bamboo, which contain much silica. The amount of ash in *Bauhinia Vahlii* is very great. Some charcoal, made of the wood, yielded no less than one-third of its weight in ash.

Chemical analysis of the ashes of 15 kinds of woods.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bark carefully removed, except Nos. 5, 14, 15 100 parts of steam dried wood contain the following :—	Shorea robusta. Moti Singh, student.	Bombax malabaricum. T. J Campbell, Esq.	Cedrela Toona. Moti Singh, student.	Buchanania latifolia. Kirpanath, student	Bauhinia Nahlii.	Tamarindus indica. ChanderKumar Chatterji	Tectona grandis. B. A. Rebsch, Esq.	Artocarpus integrifolia. Daulat Ram, student.	Quercus incana. Moti Singh, student.	Pinus longifolia. J. E. Barrett, Esq.	Pinus excelsa. Moti Singh, student.	Cedrus Deodara. J. E Barrett, Esq.	Abies Smithiana. A. E. Lowrie, Esq.	Phœnix sp utis Newalik F reats. Daulat Ram, student.	Dendrocalamus strictus. Daulat Ram, student.
	Sal.	Simal	Tun.	Pial.	Maljhan	Imli.	Teak.	Kathal	Ban.	Chir.	Kail.	Deodar	Rai.	Kajur.	Bans.
Potassium carbonate... including in some cases sodium compounds	0 01	0·01	0·07	0 20	0·22	0 15	0 03	0·03	0·06	0·01	trace	0·03	0 01	0·16	0·06
Potassium chloride ... including in some cases sodium compounds	0·01	0·03	0·02	0 06	0·10	0·15	0 01	0 02	0 01	0 01	0·01	trace	trace	0·16	0 05
Potassium sulphate ... including in some cases sodium compounds	trace	0·13	0 02	0 03	0 10	0·15	0 09	0 05	0 01	trace	0·01	0·02	0 01	0·22	0·06
Phosphates of iron, aluminium, calcium, magnes.	0·02	1·65	0 62	0·28	0 53	0·68	0·31	trace	0·10	0·01	0 02	0·05	0·44	1·06	0·71
Calcium carbonate . .	0 24	0·79		0·47	9 75	1·37		0·37	0·25	0 12	0·05	0·16		0 21	0·20
Magnesium carbonate	0·16	1·65	0 17	0·38	0·82	0 68	0·21	0·03	0 16	0·02	0·03	0·04	0·13	0·84	0·10
Silica and impurities insoluble in acids...	0·02	0 07	0·01	0·05	0 23	trace	0 12	0·20	0 03	0·16	0 02	0·03	0·04	1·39	0·78
TOTAL ASHES ...	0 46	4·33	0 91	1·44	11·74	3·18	0·77	0 70	0 62	0·33	0·14	0 33	0 63	4·04	1 96
Flame re-action of soluble salts ...	Yellow, may be 5 per cent. sodium, 95 per cent potass compounds	Violet	Violet	Violet	Violet.	Violet	Violet and yellow may have 5 p. cent Sodium compounds	Violet nearly pure potassium.	Violet perfect potassium flame.	Violet	Violet and yellow perhaps 5 per cent sodium compounds	Violet pure potassium.	Violet	Violet	Violet
100 parts of steam dried wood weighed air dry	129·9	118·4	114·3	114 9	111 1	112·3	114 7	140 7	108·1	117·3	114·9	114·7	108·7	126·6	108·2

Forest Soils in Coorg.

The following facts regarding the forest soils in Coorg will be of interest; they somewhat upset the generally received theories as to the formation of vegetable soil in forests.

Coorg, as will be seen from the map, is a little country occupying a small portion of the Western Ghats, and jutting out a short distance in the Mysore plateau. The Western slopes of the Ghats are covered with dense lofty evergreen forest, into which jungle fires never penetrate. On the east is a belt of deciduous forest, varying from four to six miles in width, which have been constantly burnt through by jungle fires for time out of mind; and indeed we may infer that this has been going on for centuries. Do not we all know that the natives of India always burn the forests on principle, in order to get an early crop of young grass for their cattle; in fact they consider it a duty they owe to themselves and their neighbours to burn off the forests as completely as possible. Is it likely that this is a habit developed of late years, and not rather one as old as the first settlement of inhabitants in the country? Then that the forest has been much in the same state for the last 500 years is proved by the existence of teak trees of that age, which evidently grew in the same conditions from the first as they are doing now. The almost invariable wide centre rings, two to three in the first inch seen in these ancient trees, would appear to give direct evidence of the young plant having been constantly burnt down every year, every time sending up a larger shoot until a shoot is produced large enough and high enough to defy the jungle fire. This is the process to be seen going on under our own eyes. A teak plant, grown under other conditions in the forest, would have six or eight rings to the first inch. We may then I think infer that these deciduous forests were constantly run over by fire 500 years ago, and have been ever since, and probably were burnt for centuries before that.

Now what is the result on the soil?

In the one case we have the virgin evergreen forest of the Ghats in which fire never penetrates, constantly giving back to the soil a vast amount of vegetable matter in the shape of leaves, wood, and bark. On the other hand high deciduous forest, the vegetable matter from which has been constantly burnt by jungle fires for centuries. According to preconceived notions there would be a thick layer of vegetable mould in the former, and next to none in the latter. As a matter of fact the very opposite is the case. In the Ghat forests there is seldom more than an average of six inches of vegetable mould, whereas in the deciduous forests there is thickness of from 1 foot to 28 inches. It must be distinctly understood here that I am not speaking of scrub jungle, but of high and fairly well stocked deciduous forest.

In open scrub jungle the formation of vegetable mould is naturally very much less, and, as might be expected, if the subsoil is examined, it will generally be found to be poor. No doubt there are other circumstances conducing to the poverty of the jungle, and amongst these chiefly the want of rain, and these causes act and react on each other.

The difference in the soils of evergreen forest and deciduous forest is very distinctly marked on the lower western slopes of the Ghats. Here, up to an altitude of 800 to 1,000 feet, the slopes are covered with semi-deciduous forest of *Terminalias* and *Lagerstrœmias* mixed with the large thorny-bamboo, the greater portions of which are burnt almost annually. In coming down the Ghat roads the difference in the soil of the road cutting is at once noticed; between the thin greyish layer of the vegetable mould of the evergreen, and the thick black layer of the fire devastated deciduous forest, I have noticed the same thing on the Carcoor Ghat from Niligiris to Calicut. A few days ago, in going through a coffee estate on the Ghats, I passed a place where the soil was a rich deep black resembling what is seen in the eastern deciduous forests, strongly contrasting with the absence of mould in surrounding portions of the estate. It had been lately dug, and on looking closely, I noticed a number of pieces of charcoal mixed with the soil. On remarking on this I was told the place was the site of a toddy drawer's house and garden, and the rich black mould was evidently partly produced from burnt vegetable matter.

The fine coffee estates in what is called the "Bamboo" district in Coorg owe their flourishing condition to the rich black vegetable soil of the deciduous forest. In the first days of coffee planting, every one thought that the soil of the dense Ghat forests must be everlasting, as compared with the deciduous, but the fallacy of this supposition is proved by thousands of acres of abandoned coffee states on the Ghats, whereas estates planted fifteen years ago in the "bamboo" are as flourishing as ever and shew no signs of decay. Supplies come up as well as when first the estate was planted, shewing that the soil retains its vigour. In the Ghats it is not so, the exhausted soil refuses to rear the young plant, so that vacancies cannot be filled up. And it is remarkable that this is not only the case on steep slopes, but also on flat places and hollow where there can be put little wash.

I trust that these observations will bring out those of other observers on the subject.

COORG.

JJ. Reviews.

Forest Administration Report of the Madras Presidency for 1880-81.

By the kindness of the Conservator, Major Campbell Walker, we have been favoured with a copy of the Madras report, which completes the series of reports which we have reviewed in our April and July numbers. We wish we could give a good account of the state of forest conservancy in Madras, but there is, unfortunately, only too much internal evidence in the report before us, of the difficulties entailed by the absence of a proper forest law; and the consequence is that there is evidently not only very little system at all, but what there is, is so constantly changed, that true conservancy, which must always depend on good, even though elementary, arrangements being permanently made and only altered by progressive improvement, cannot well exist. Fuel reserves are transformed into forest reserves, and *vice versâ*; the forests protected one year from fire or from cattle are thrown open the next to indiscriminate grazing or unchecked burning; and the systems of revenue collection are altered and re-altered. We quote Colonel Beddome's para. 162, on the subject of a Forest Act which will explain well the condition of things in the Madras forests, during the year 1880-81 :—

"A steady annual improvement in our reserves and forests cannot be expected until a Forest Act gives definition to our forest laws, and regulations throughout the Presidency, and strengthens systematic conservancy. At present we almost entirely depend in each district upon the support which the Collector for the time being chooses to give. Tracts treated as reserves one year are perhaps thrown open the next, and our officers are quite at sea with reference to any definite system for checking smuggling, forest offences, &c., because we have no proper code of rules, and what we have differ in different districts, and are often not upheld, or constantly being altered, and punishments, when obtained, are often so lenient as to be a premium on the breach of the Forest Rules."

Henceforth we trust all this will be at an end. For under the enlightened rule of the present Governor, and the assistance of Dr. Brandis, a Forest Act was passed on August 26th; and arrangements are now in progress which should place forest administration in Madras on a proper footing, consistent with the place which Madras ought to take as having been in reality the pioneer of forest conservancy in India.

Here, in Northern India, most of us have only the vaguest and most general idea of the forest system of the Southern Presidency. We know that all the officers, except the Commissioner, are styled "Deputies;" that Madras refused to accept more than two of the Nancy trained forest officers sent out from home; that in most years, so far from paying its expenses, forest work has given a decided deficit; and that the determined opposition of certain Madras officials, and notably Sir W. Robinson, has resulted in the alienation, or probable alienation, of some of the most valuable forest property which exists in India. But beyond this we know little, and we regret to say that there is little to enlighten us in the report now under review.

A very serious drawback to the utility of the report is the absence of the well known statements which our forest code prescribes, and which for the Indian and Bombay circles give, almost alone, a clear account of the state of conservancy. There is not even an area statement of reserves, no record of the progress of fire protection; the plantation results are relegated to a table in the body of the report; while the space usually devoted to returns is occupied by six complicated and useless timber forms, and a financial statement. We trust that one of the first acts of Government, under the new *regime*, will be to order the introduction of the forest code; and if this is done we may hope another year to be able better to contrast the work done, and the results of conservancy in Madras with those of the provinces of the Bengal and Bombay presidencies.

The first part of the report treats of three description of forests *viz.*: II *A*, Reserved Forests; II *B*, Fuel Reserves; and II *C*, Plantations.

We have tried to prepare for ourselves a list of the reserves in the different districts, but information is only given as regards one or two such, as Godavari 68 square miles, North Arcot 93, Tinnevelly 287. The very meagre accounts of work done in the constitution, demarcation and protection of the reserves afford almost no information that is worthy of note, except the successful settlement in favour of the Department by the High Court of Madras of one of the South Kanara claims. But in para. 48, the total area of reserves is given at 806 square miles. In the account of the *Fuel Reserve* there is equally little information to be gained. Everything is subordinated to the "number of tons of timber cut;" and it is characteristic of Madras management that in Palghat a fire is said to have broken out and burnt two days, but did no serious damage. We wonder if any attempt was made to extinguish it by the forest guards, for we suppose there are forest guards in Madras; and if the Assistant Collector will have some help in watching his 15-foot firepath which is to be the great protector in the future. We wonder,

too, how much good a 15-foot firepath would be in Northern Bengal or Burmah, without patrols and with grass on either side 10 to 15 feet high.

The total area of Fuel Reserves was 250 acres, the greater part of which however was only insufficiently stocked.

The accounts of planting operations are much better than those of the reserves, though very little is told us in the report regarding them; and especially regarding Nilambur and the Eucalyptus plantation on the Nilgiris. A table gives the area of plantations at the end of 1880-81 at 8,820 acres, the financial results of which up to date were—

Revenue Rs. 3,20,308
Expenditure „ 7,18,728
} Deficit Rs. 3,98,420

The total expenditure per acre has, therefore, been Rs. 81-8, a heavy rate, and one which seems, with other evidence, to show that an undue proportion of the expenditure of the Madras Forest Department and of the time of its officers has been spent in plantation work, to the neglect of the first elements of forest work demarcation and the management of existing forests. The financial results of the year were

Revenue Rs. 4,86,715
Expenditure „ 3,51,999
Surplus Rs. 1,34,716
} a result which with a Forest Act and under a system of proper reorganization will probably soon change materially.

It must not be forgotten that the average surplus of the six preceding years was only 4,638, so that 1880-81 already shews an improvement.

Before closing our review of the Madras report we must notice the results of experiments made at the gun carriage factory at Madras, on the weight, &c., of planted Nilambur teak. These gave

	Age	Weight in lbs. per c. ft.	No. of Expects.	Length of Bar	Seate area of Bar	Break Weight.
No. 1	60	38	6	3ft.	1¼in	753
„ 2	30	57	6	3ft.	1½ „	627
„ 3	32	41	6	3ft.	1½ „	870

As we do not know the depth and breadth of the bar we are unable to calculate P which $= \frac{W l}{b d^2}$ All we know is that $bd = 1\frac{1}{2}$. If we assume, as is probable, that $b = 1$, and $d = 1\frac{1}{2}$, we have P = 1,004, 836, and 1,160 respectively, all very high rates compared with P = 600, the figures which are usually adopted.

We have now received all the provincial reports for 1880-81, and there is nothing left for us but to recommend attention to the Inspecter-General's general review, which we do not purpose to consider. All we will do is to draw the attention of of our readers to paras. 17 and 18, and ask them to note what is therein stated as bearing out our remarks in our April number.

Report on Forest Administration in the Central Provinces for 1881-82.

THIS report was submitted on 26th August last, and reviewed by the Chief Commissioner as early as 11th September. Major Doveton accounts for the delay in its submission by the weakness of the Divisional Office establishments. This defect in the organisation of the Department is of long standing, and requires urgent reform. Some of the Divisional Offices possess no clerks, while only two, both of which have very heavy work in connection with accounts, have only two clerks each. Besides this, there is no regular grading of the men, the salaries are generally absurdly low, and promotion is so slow that a good man must consider himself lucky if he gets on an average one step every 10 years. The result of all this is that the Divisional Officers are too much tied down to mere mechanical, clerical, and accounts work, and are unable to devote their full energies and time to the true work of a forester.

In the first class reserves, aggregating 2,588 square miles, and scattered over an area of upwards of 30,000 square miles, there were only 451 cases of breach of forest laws reported. In three cases alone were the offenders undetected, while in as many as 427 the persons concerned were allowed to compound; so that it was only in 21 cases that prosecution was resorted to, conviction being obtained in 18. In the second class reserves, which cover 16,842 square miles, spread over the whole area of the provinces, 8,779 cases were reported—777 gave occasion for prosecution, convictions being obtained in 716. In the remaining 8,002 cases the persons involved were allowed to compound. These figures point to commendable efficiency on the part of the establishment, and a wholesome respect for the forest law among the people.

Major Doveton very properly meets the statement of the Inspector-General of Forests, that "the so-called second class reserves are, to all intents and purposes, unreserved forests," by drawing attention to the fact that under the forest law they are really and truly reserved forests, and, as such, are secure against the acquisition of rights, none of which fortunately exist therein. In this respect the Central Provinces possess an immense advantage over other provinces, where the acquisition of more reserved forests, in spite of their present inadequate area, is impossible, or necessitates the slow, cumbrous and expensive process prescribed by the opening sections of Chapter II of the Forest Act. The retention of the large area occupied by the second class reserves is in no sense a source of hardship to the people, or embarrassment to the government. Land required for cultivation can be at once given up under a mere administrative order of the Supreme Government. Every facility is afforded to the people for supplying their requirements in

respect of forest produce, and as soon as the development of any part of the Provinces calls for the stricter protection and conservation of a neighbouring tract, which was previously practically of little value, an administrative order of the Chief Commissioner suffices to place it on the footing of a first class reserve.

As stated *en passant* before, the first class reserves aggregate 2,588 square miles. This is certainly a very small area, and is very little more than that it was six years ago; so that the charge of the Supreme Government to the effect that the extension of first class reserves has been neglected is to the point. The conservator replies that this charge does not hold good for at least the Nimar division. Nevertheless, as he himself admits, the question as to what portions of the second class reserves should be converted into first class reserves, was practically settled as long ago as in 1879. In that year, and in 1880, as the annual reports show, a certain number of these areas were demarcated, *viz.*, Bainpura, Gunjari, Undria-Baoria, Bhojwa and Beheria, Ajnal and Chaoria, all of them most admirably situated for export. But up to the year under report the simple measure of obtaining the Chief Commissioner's sanction does not seem to have been taken. Moreover, the facility which the complete freedom from rights of the second class reserves offers for the permanent reservation of any tract, leaves no excuse whatever for tardy progress. The portions of the second class reserves that ought to be at once brought under complete protection are extremely well defined, although there may yet be no likelihood of an immediate demand for produce from them. For instance, the once highly cultivated Manjrod Pargana, north-east of Burhanpur, is now a howling waste; but the rich soil, level land and abundance of fertilising water near the surface still remain, and it only requires the loyal carrying out of the measures initiated after careful deliberation in 1879-80 to resettle all that magnificent tract. In view of returning cultivation the necessity of at once permanently reserving the Sambar Deo Hill, including the level land on both sides of the river Tapti, leaps to the eyes. In the same way the resettling of the fertile valley round the fortress of Asirgarh, which was commenced in 1880, and which ought already to have resulted in several flourishing villages, marks out clearly the urgency of placing certain neighbouring teak-bearing tracts on the footing of first class reserves. The Kanhapur-Berian tracts, which adjoin the most highly cultivated portion of British as well as Holkar's Nimar, and which are consequently in a most exhausted condition, ought to have been made first class reserves many years ago. And so on for the remaining tracts, the permanent reservation of which was decided on in 1879. Some of these tracts are conterminous with proprietary villages, the boundaries of which are

open to dispute; but the rest are surrounded on every side by government forests, and could be taken up after the mere trouble of going round them with some surveying instrument, and putting up boundary marks. A fairly intelligent officer, properly aided, could do at least four miles of such work a day.

After most unaccountable delays, extending over a period of about fifteen years, the valuable forests in the Raipur district are at length being attended to. Lieutenant Forsyth examined them many years back, but no one in the Forest Department seems to have been aware of their great value until last year, when Mr. Richard Thompson was deputed to study them. It is a pity that the extremely able and interesting report which this latter officer submitted to his administration has not yet been published. Mr. Thompson's examination has disclosed the fact, hitherto, we believe, quite unsuspected, that the unrestricted felling and export of magnificent logs of sal and teak has been going on for a long time on a considerable scale, resulting in the destruction or impoverishment of many a fine forest.

These forests ought to have been taken up as first class reserves long ago, and we can only attribute their being left to take care of themselves to the weakness of the superior establishment. To those who know anything of forest matters in the Central Provinces, and the immense area over which the forests are spread, and the comparative inaccessibility of half of them, the necessity of a second conservator and half a dozen more divisional officers is indisputable, and urgent in the extreme. The additional expenditure which such an accession of strength will involve, will be more than compensated for by a large enhancement of revenue. We do not hesitate to say that with two conservators, and every division properly manned and organised the gross forest revenue of the provinces would be doubled in five years. It is to be regretted that the new scheme, just passed by Government, does not provide for this crying want. But we can still make the best of what we have got by extending the Berar conservator's control to some of the adjoining forest divisions of the Central Provinces, for instance to Wardha, Nimar, Betul, Hoshangabad, Damoh, Jabulpur, Saugor and Narsingpur. The conservator of forests at Nagpur could then devote all the attention which they require to the forests of the eastern districts, which are now being rapidly opened out by means of roads and railways. With his reduced charge, there will still be quite enough of work to occupy fully the time of the most industrious and active departmental chief.

Regarding the boundaries of first class reserves we have very little to say. In most cases they are marked out by cleared lines. Many of them, however, require to be

permanently fixed by means of numbered pillars or posts rising out of a cairn of stones. And all of them, with very few exceptions, also require being interpolated on good maps after an accurate survey. Some of these boundaries have never been surveyed.

We now come to the vexed question of prevention of fire. First we must note the clerical errors which resulted in a discrepancy of more than 32,000 acres in the protected area returned last year. These errors show very great carelessness in preparing the returns. We are at a loss to discover how such large errors escaped detection, especially as monthly returns are submitted to the Direction Office, which also requires in the first instance a map and description of the boundaries of each area before its protection from fire is undertaken.

The aggregate area in which protection was attempted was a little over 900,000 acres, of which nearly one-seventh was burnt. One forest of 3,548 acres, as well as nine blocks of Punasa, aggregating 84,610, was entirely burnt. Large failures occurred in seven other forests. The largest failure of all certainly occurred in Punasa. Here the fury of the fire was so great, and it swept on so rapidly, that all those who came to put it out had to flee before it for their bare lives. Six men were burnt to death, the rest, owing to the cool courage and presence of mind displayed by Forest Ranger Mahado Rao, escaped by taking advantage of a clear space, whither they took refuge. The Ranger's pony was also burned to death. The Conservator attributes this conflagration to a whirlwind which carried fire across the insulating path along the boundary, lighting the forest in three separate places at once. Unless we are mistaken, the blocks were insulated by fire traces all round them, while some of them were also traversed, and thus split up by means of interior traces. Major Doveton's explanation is, therefore, unintelligible, except on the assumption that all these fire-traces proved useless. If this assumption is correct, then these fire-traces must have been extremely badly cleared; and, if they were well cleared, then their width was quite inadequate. Under either supposition somebody is to blame for either great carelessness or singular want of judgment; but the more probable explanation of the wide area over which the conflagration swept is evidently incendiarism. This explanation is supported by the previous partially successful combined attempt of incendiaries, and the account of this fire itself, which account has reached us from private sources, would make it appear that the jungle was seen to burn at nine different places at once. Under any other circumstances the localisation of the fire, especially by such an experienced and cool-headed Ranger as Mahadeo Rao, would have been an easy matter.

Major Doveton says: "The success that has been attained

in certain forests, and under certain conditions, and the results it has given even where fires have occasionally occurred, has led to the system in force being overrated. The unfortunate fact is that it is least adopted to those forests which Government is most desirous to improve, *viz.* those that are most accessible, and consequently at present least productive in tree vegetation. In this matter I am prepared to go further than does the Inspector-General of Forests in para. 30 of the Review of Forest Administration in the Provinces under the Government of India for 1880-81, and to state that by it perfect immunity from fires cannot be rendered sure, at least in the dry forests of these Provinces.

"In the first place the very measurers adopted for prevention are, to a certain extent, a source of danger, owing to no imperfection in the system prescribed, but to the impossibility of relying on every official doing the right thing at the right time; and putting aside this difficulty, except at a very high cost, it cannot render access to the forests except by fixed routes impracticable, while it affords no obstruction to the passage of fire carried by wind. For the latter purpose broad lines have to be resorted to, whereby tracing is rendered a greater source of danger.

"Fencing and the raising of evergreen belts has hitherto been regarded as impracticable, but I am by no means sure that they will not be fallen back on as the surest, and, in the end, the most economical means of securing fire-protection. At any rate I am of opinion that this should be fairly tried, and, that until it has been tried, the extension of the present system, except to protect a season's crop of grass for sale, or small areas in which special works are carried out, should not be attempted."

Major Doveton will excuse us if we say that we disagree *in toto* with his main conclusions and the manner in which he arrives at them. And we will now show why.

In the first place it does not follow that the forests which we are "most desirous to improve" are necessarily those which "are least productive in tree vegetation." Really it is those which are situated nearest the large centres of consumption, or from which there is already, or is expected shortly to be, an established export of all or the greater part of what it can produce, and this quite regardless of the actual condition of the forest as we find it when we place it under conservation. But this is only a side question. What is more to the point is, that such forests, being most largely frequented by purchasers of wood or their servants, are exposed more than any other to the risk of fire, either from carelessness on the part of these men, or from malice, or again from a pure spirit of wantonness. Moreover, as such forests are often situated in the vicinity of a large population, the chances of their being

fired are obviously still further increased. Now nothing short of a stout durable masonry wall, high enough to prevent a burning fuse being shot over it from a rifle, would bar outsiders from setting fire to the forest inside ; and as, for purchasers, wood-cutters and others permitted to enter the forest, it would be as absurd to expect them all, without exception, even under the strictest surveillance, to hold their hand, as it is to expect mankind generally to abstain from committing theft and murder. The Inland Customs line was planted with a dense thorny hedge and guarded by one man for each mile of its length, but that did not put a stop to smuggling. Then, again, can we always be sure of our own establishment? May they not be open to bribes, or even fire the forests with their own hands? Major Doveton himself has had to report more than once such misconduct on the part of his men. Indeed it seems unnecessary to waste time in establishing such an obvious fact that nothing in the world will deter people from occasionally firing the best guarded forests, either in order to satisfy a grudge, or from a spirit of pure mischief, or unintentionally through carelessness.

The fallacy in Major Doveton's reasoning is due to a tacit assumption that it is possible to render the prevention of fire in forests a mathematical certainty, otherwise why should he condemn the very excellent system generally practised in his charge, because "by it *perfect immunity* from fires cannot be rendered sure, at least in the dry forests of these provinces?" This impossible assumption must be traced back to the remarks made by the Inspector-General of Forests in his Review of Forest Administration referred to in the paragraphs extracted from Major Doveton's report. Even if we could go back to the golden age, or bring about a millennium upon earth, the risk of fires in forests could not altogether be prevented. Houses are sometimes burnt down by some careless act on the part of their owners, who would be the last persons in the world to willingly destroy their own property. All that we can do is to go on extending, in proportion to the means at our disposal, our operations for the prevention of fire, and to minimise to the greatest extent practicable the chances of failure.

Placing ourselves at this point of view, let us examine the relative efficiency of "fencing, and the raising of evergreen belts," the measures which, in Major Doveton's opinion, will ultimately "be fallen back on as the surest, and in the end the most economical, means of securing fire protection."

We will first consider "fencing." If under this is included walling, we have already shown that to be effectual against outsiders it must be so high that its erection would be out of the question. Even to oppose the passage of fire carried by wind, it must be impracticably high. Who in teak forests has

not observed burning teak leaves carried up several hundred feet, and dropped on the ground in an incandescent state? Thus walling as a means of keeping out fire is quite inadmissible. Is a live fence of more practical utility? It is certainly a much less effectual barrier than a wall, and can never be raised to the same height. To keep it full at the base it must be continually trimmed down. To raise it, the soil must be suitable; but a single day in the dry forests of the Central Provinces will show that for one mile of suitable soil there is another of rock or stones, which would require soil to be brought from elsewhere. After the hedge has been sown or planted, it will have to be protected from fire during the whole of its existence. Herbaceous vegetation is generally most luxuriant along hedges, and fire reaching a hedge will generally burn more fiercely than before, unless this vegetation is removed. Allow fire to enter the best kept hedge for two or three successive years, and large gaps will be produced. Why have hedges along lines of railway failed, in spite of good soil, and constant care, and supervision? They were continually breached by fire. Why are the Inland Customs hedges now abandoned fast disappearing except in a few favorable places? Chiefly because fire is killing out the plants. But even in the palmiest days of the salt line, was its hedge ever in a state to prevent the passage of fire? A hedge round a forest implies in most cases the artificial fostering of plants unsuited to the soil and locality. If then annual fires are generally sufficient to prevent a complete growth of indigenous trees from springing up, what must it be with the delicate strangers forming a hedge? But even granting that a hedge can be raised, offering an insurmountable obstacle to the passage of fire, it must be quite as wide as the widest fire-trace of the present day, that is to say, in the dry open forests of the Central Provinces from 300 to 900 feet broad! Is then the raising and maintenance of such a hedge a less troublesome or more economical business than the clearing of the present fire-traces? We have seen that to maintain the hedge we must preserve the hedge itself from fire, in other words continue to make the present fire-traces. Here is a *reductio ad absurdum*. But to go to the root of the matter, the establishment of a continuous hedge of this description, save in exceptionally favorable soils, is a physical impossibility. Attempts have been made in the Central Provinces as well as elsewhere and have failed, and will fail again.

We now come to "evergreen belts." What are these evergreen belts expected to do? They are to prevent a growth of grass and other herbaceous vegetation, which in the hot weather become inflammable. In other words by their means purely natural forces are expected to keep clear a line which now requires expensive annual burning, itself

full of danger when carelessly managed. The trees forming the belt will recoup the cost of their establishment and maintenance by the timber, and, in some cases, fruits that they will yield. Where such belts *can* be established, we grant their efficacy. But what proportion of the length of the boundaries of our forests actually offer the necessary conditions for raising them? Is it even one-twentieth? We most decidedly reply, No. After all that can be said in favour of evergreen belts, we must not forget that they will be extremely costly, especially as they must be maintained so full as to prevent grass and other herbaceous undergrowth coming up. For a great many years they will themselves have to be protected from fire by means of a double line on each side of them; and we suspect that even, when completely established, the herbaceous vegetation on each side will have to be cleared every year for several feet, otherwise fires, which must generally be annual outside the forest, and certainly occasional inside, are bound to encroach steadily on them. Besides, all the dead leaves that fall will have to be swept away as fast as they accumulate on the ground; as in the case of hedges, these belts will have to be broad enough to prevent burning leaves from being blown over across them. The maintenance of the leaf canopy in a complete state will always require special care and precautions. It must not be forgotten that mango groves, left to themselves, soon become more and more open, and gradually allow herbage to come up under them until the quantity increases sufficiently to connect the dry grass outside with that inside the forest. A small beginning in raising chiefly a mango belt has been made by Mr. Whittall in the Nimar division, but Major Doveton gives no details whereby we can judge to what extent success has been attained during the first year. A similar experiment has been tried with mango in the Betul division, in which out of 217 plants put out 71, or nearly 33 per cent, were already dead in their first year.

We must make a remark here in connection with these experiments. They are far too small to furnish conclusions of a sufficiently general nature. A few hundred plants are easily looked after, can indeed receive all the careful tending of orchard trees, and their success is apt to raise sanguine hopes that might lead to severe disappointment hereafter when work is attempted on a larger scale.

After admitting the efficacy of evergreen belts so far as they prevent an undergrowth of grass and other vegetation that becomes highly inflammable when dry, we have shown that they cannot be raised except along a relatively very small aggregate length of the forest boundaries; that they are extremely costly and difficult to establish and maintain; that even after they are fully established they must themselves be secured against the encroachment of fire; and that to serve as

barriers to the passage of fire, the dead leaves they shed must not be allowed to accumulate under them. Where they can be successfully and occasionally established and kept up, let us have them by all means. They help to mark the boundaries, and render productive a really considerable area that would otherwise furnish little revenue. To say of them that they would deter *badmashes* from firing the forests would be as incorrect as to say that open doors would deter burglars.

Do what we will, forest fires can no more be entirely prevented than theft or murder. But because they cannot be entirely prevented, that is no reason why we ought not to extend protection to all our valuable forests whenever we have adequate means at our disposal. If we accepted that reason, we should never get beyond nearly *attempting* to protect the very first small tracts that we took up experimentally; we should be exactly in the position of the clod who, instead of at once fording the river before him, sat on the bank waiting for the river to run dry, which nevertheless flowed continually on. The first and chief element of success in the prevention of fire is the conciliation of the good will and active co-operation of the people. These once secured, and a judicious system of sufficiently wide fire-traces completely cleared, successful protection is as certain as anything under the sun can be. This being so, we cannot but lament the new policy adopted by Major Doveton of stopping all extension of fire prevention operations except in order to secure better boundaries, and his entire acquiescence in the strictures passed on the previous year's work by the Inspector-General of Forests. We are sure that Dr. Schlich will modify his views, and qualify very considerably the sweeping condemnation conveyed in those strictures after he has examined the forests of the Central Provinces and observed the radical changes for the better worked in them by even the supposed imperfect system of fire prevention hitherto followed. Major Doveton's present report itself supplies us with an argument in support of our position. He says: "Two small forest areas, that had been accidentally burnt after several years of successful protection, were, in the past year, closely examined, and the conclusion drawn was that, though in such cases fire may do more damage than in areas that have not been protected, as a rule it can only, to a very *limited* extent, modify the benefit that has resulted from previous protection."

We must apologise for having dwelt at such length on the subject of the prevention of fire; but our best excuse is to be found in the important issues involved. Indeed we have been obliged, in order not to tire our readers, to omit to notice many very interesting facts connected with that essential part of the Indian forester's duties.

On the subject of "reproductive measures" Major Doveton

formulates the dictum that "in most of the forest areas protection affords the widest field for improvement, and outlay on planting can only be justified in exceptional cases to supply special demands, and in some cases to improve the composition of the forests." Here, again, we are obliged to differ from him. We admit that there are certain forests favorably circumstanced in respect of all the three main factors of growth, *viz.*, species, soil, and climate, for which mere protection suffices. Sal forests are very generally so situated; but in the case of teak such forests are the exception, and unless we are willing, or can afford to wait, protection, unaided by active measures of reproduction, will generally be found too slow a process. An examination of four out of five teak producing forests, protected during say the last ten years, will prove what we have just said. Actually they are little better than more or less open miserable scrub; whereas successful artificial measures would have already resulted in greatly improved composition of the forest and a healthy, more or less complete, growth over one-fifteenth of the total area (allowing, for the sake of argument, a term of 150 years for the operations to go over the entire area).. This is of course on the assumption that we already know the best methods for restocking under different circumstances. Major Doveton has laid down a general rule, and we have, therefore, criticised it from an equally general standpoint.

But actually we are only now beginning to study how to plant and sow under different conditions, and how to carry out the various fellings for securing natural regeneration. Considering that our department has been in existence for more than 20 years, this admission is not flattering to our self-esteem. But we must frankly make it—for the beginning of all knowledge is a confession of present ignorance. It, therefore, behoves us, and is our bounden duty, to display more activity than we have hitherto done in studying the best methods of regenerating or creating forests of different species under the most diverse conditions of soil and climate. If we are to admit the truth of the dictum laid down by Major Doveton, and sit with folded hands when we have secured nothing more than mere protection for our forests, then we may hand over our forests to civil, or better still police officers, and to wood contractors, and depart for countries in which the profession and art of forestry is something more than a mere name. But Major Doveton himself is not true to his dictum, and tries to carry out various operations for the improvement of his forests, and the only point on which we have to express our difference with him is that we consider that he does not display sufficient activity. To prove our position we have simply to quote figures from his report. Out of a total of Rs. 3,17,743 entered under head A (Conservancy and Works)

only Rs. 8,545, or barely one-fortieth, were spent on measures for reproduction and improvement of present growth. *Verbum sap.*

With regard to sowing and planting operations having for object the filling up and improvement of the present extremely open and badly grown crops, the dry district of Nimar certainly offers the greatest difficulties. The rainfall is only about 27 inches, and is, besides, very fitful and uncertain. The monsoon of 1881 was an average one, nevertheless read what Major Doveton says of it:

"Rain fell early, *viz.* in the latter part of May, but soon stopped. There was no more till 3rd July. * * * * At the end of ten days (from that date), the rainfall became so uncertain as to necessitate the work (putting out of teak plants) being stopped. From 9th July to the close of that month there were only six days on which rain fell in such quantity as to be of any use to transplants. In August there were only three such days, and in September but one."

To be able to command success in sowing and planting operations in Nimar is to be able to command success everywhere else in the Central Provinces.

The previous year, 1880, was still more unfavorable. The first shower of rain in the Khandwa Reserve fell on 6th September, and the extensive sowing and planting works which it was found necessary to undertake in order to keep together a large gang of trained wood-cutters who were required early in the cold weather, and who were the only men available in the whole district for the purpose, proved a failure. Owing to this failure the operations undertaken in 1881 in the same reserve were comparatively circumscribed. It was intended to plant up 38,000 pits with teak and bamboo, but owing to the fitful rainfall only 5,808 plants could be put out. Many of these died. As Major Doveton observes: "Without artificial watering, *the necessity of which was never contemplated*, the result was not satisfactory." Why *never contemplated?* The necessity of artificial watering was clearly established in the previous year, and there can be no doubt that the failures of that year would not have been so complete had the watering of the plants not been stopped, as it unfortunately was in spite of the most obvious indications of its necessity. But we can only live and learn.

The Saugor division was the only other division in which planting on any noticeable scale was attempted. The species propagated was the *Dendrocalamus strictus*. The results were not so good as those of the previous two years. Taking the combined work of the three years, about 120,000 plants were put out at a cost, in round numbers, of Rs. 4,100. The

number alive at the end of the year was about 65,000, so that the average cost per plant is about one anna. This figure is rather high, but Mr. Foster deserves much credit for the very fair amount of success attained.

It would be advisable to give every year a synoptical table for each sowing or plantation, showing progress, casualties, repairs, &c. It is not always easy to judge of the success or failure of such works in the first or even the second year after they have been commenced. For instance, the sowings made by Mr. Moir in, we believe, 1875, on the Nagpahar near Ajmir, were considered to have failed completely, and were accordingly altogether abandoned; nevertheless, when examined less than two years ago, a large percentage of the plants were still surviving. Similarly, to take instances from Major Doveton's report itself, sowings made in the Moharli Reserve by Mr. Thompson, and in the Rajaburari and Saonligarh Reserves by Mr. Fernandez, and continued by Mr. Thomas, which had been reported as more or less complete failures, are now spoken of favorably. Of the former work Major Doveton says that "though the plantings of teak * * * were reported in previous years as unsatisfactory, the experimental plantings in broad cleared bands near Moharli itself promise well, notwithstanding that some of the trees were injured by an officious subordinate." Of the other work he writes: "It now appears that the efforts made in previous years to stock blanks by broadcasting seed, and sowing in ploughed lines, or roughly prepared plots, though they have not resulted in full crops, have at least resulted in the production of a very large number of seedlings where the ground would otherwise have remained bare except of grass." It must be remembered that these sowings cost only about Re. 1 per acre. They were the first of their kind, and had they been continued, the system on which they were executed would most probably have been perfected during the six years that have since elapsed. The rains and other climatic conditions are very suitable, and the plants that now survive have lived through two successive years of exceptionally severe frost, although they had been left quite uncared for from the very second year after they came up. The work seems to have been discontinued or not prosecuted with the necessary care and *esprit de suite*, and the opportunity of gaining experience and six whole years have been lost. We may cite one more case. Some sowings were made in Punasa in Nimar in 1880, the rainfall in which, as already mentioned, was very late, short, and fitful. Seed had to be sown twice, and in some places even three times, as the slight showers followed by long breaks of hot sunshine killed off the germinating plants. The sowings seem to have been only casually examined, and the work was at once reported a complete failure. Nevertheless, as we have been informed, countings made at the beginning of the past rains

showed that about 30 per cent of the seedlings were still alive. The annual submission of a synoptical table, such as we have recommended, will obviate in the future similar errors of judgment and loss of opportunities and time.

(*To be continued.*)

Progress report on Forest Administration in the Punjab, 1881-82.

THIS is the first of the provincial reports which has reached us. It is written by Major Van Someren who, however, took over charge of the Conservator's office after the close of the financial year to which it relates, the office having been held by Dr. Schlich for part of the year, and for the rest by Major Bailey. The composition of the report receives the praise of the Lieutenant-Governor, who is also satisfied with the working of the Department during the year.

During the year four officers of the superior staff, and three foresters, attended the Dehra Forest School; and Sir Charles Aitchison hopes that the subordinate staff will be kept up to its full strength, so that as many as possible of the rangers and foresters may benefit by the instruction given there. Two non-commissioned officers of the native army have received appointments as foresters, and it is proposed to appoint a third, so that this scheme may receive a fair trial. We would here remark that, as it is essential that foresters joining the department should be young and active men, and it is unlikely that commanding officers of native regiments would spare the services of promising officers that the forest department is not likely to benefit much by these appointments; and besides this a native soldier is used to comfort, and to tidy and regular habits, and will probably dislike the rough experiences a forester has to put up with except in certain posts, such as depôts, &c., which do not involve much discomfort. During the year, 217 square miles have been added to the area of reserved forests, which now consists of 1,160 square miles. It is not stated whether any of this area is leased from native states. The settlement of other reserves is in progress; but at the close of the year it was decided by Sir R. Egerton that the valuable Kulu forests should be protected, and not reserved; and we are glad to hear that this decision is now to be reconsidered.

Good progress has been made in demarcation of the reserves.

The area of protected forests is not altered from that of former years.

There has been a considerable decrease in the number of Forest offences, and the percentage of convictions has increased

both of which results are very satisfactory, though the increase of forest offences in Kangra, where the people have been very liberally dealt with in the matter of fuel and timber, is brought to the notice of the civil authorities by the local Government.

The area of forest under the control of the department which has been burned, is said to be 15,633 acres, as against 22,073 burned last year, but it is not said whether this applies to protected as well as reserved forests.

The area of reserves actually protected against fire by special measures is, however, very small, and amounts to 6,920 acres, protected at a cost of Rs. 551, so that it will be seen that fire conservancy is only commencing in the Punjab. It is, however, noted that in Chamba forest fires are accidental and of rare occurence, and that the heads of villages can, under proper supervision, and for a small remuneration, be entrusted with the care of the forests, and that, as a matter of fact, the guards are withdrawn during the winter months, and the forests do not suffer.

Fire conservancy in the hill forests of Northern India is, in many cases, a very simple matter compared to what it is in the plains; and, with the exception of a short interval before the winter snows, and another before the monsoons, there is little danger, except on the hotter aspects, though, when a fire occurs in coniferous forest, the damage done is very great, especially when it has been protected from fire for some time. Some interesting figures are given regarding the grazing arrangements in the Lahore division which are under departmental management and on an area of nearly 210,000 acres.

The following number of beasts were allowed to graze per 100 acres:—

Buffaloes...	...	...	4·16
Cows ...	...	...	14·44
Sheep and Goats	...	...	15·95
Camels	...	...	1·15
Asses ...	...	...	0·07
		or	35·77 per 100 acres.

"This is exclusive of young cattle under two years of age, which were allowed to graze free; so that in calculating areas to be given up for cattle grazing, 2·8 acres per head are sufficient, and three acres will be an ample allowance."

The area shewn in last report under plantations, 17,127 acres, with an addition of 332 acres of new plantations, has been reduced to 16,201 acres, 1,258 acres having been struck off in Gujranwala as imperfectly stocked.

In the Changa Manga Plantation it is noticed that the area of new plantation of sisso and jand (*Prosopis spicigera*), which could be watered thoroughly, has been successful, but that the rest has failed. On 63 acres the trees were stubbed out, and on 18 acres they were cut flush with the ground. The refuse and grass were then all burned off; and in the spring of 1881 water was let in over the whole, and a good coppice growth has sprung up. It was found that, if the refuse were not burned, the watering was interfered with, and the new growth was checked. It has been decided that in future cuttings all trees over 18-inch girth should be stubbed out, except along watercourse, and that smaller ones shall be cut flush with the ground.

The following extracts will be of interest:—

"In ten acres of compartments 93—95, root cuttings which were planted out in July 1880, are now from four to five feet high.

"Much benefit resulted from the enlargement of the Gandian Rajbaha carried out the preceding year, and the canal department having agreed to the utilization of a small, and for some time disused, head above the canal belt, it has been opened out. Rajbahas and watercourses generally were cleared of silt and repaired. The total area watered was:—

1st watering	...	...	...	6,209 acres.
2nd „	...	...	...	1,851 „
3rd „	...	...	...	174 „
		Total	...	8,234 acres.

"The general appearance of the plantation is now satisfactory, Owing to timely and *plentiful* watering, several compartments in Block II, which looked sickly, have recovered. At the end of May 1881 caterpillars appeared in compartments 52, 53, and spread over the plantation, attacking also the young coppice, but they after a time disappeared; and the trees, throwing out new leaves, seem to be quite vigorous again."

In some of the compartments a number of trees were dying out, and it was found that there was a layer of kunkur in the subsoil, but that the roots of the trees had penetrated this, and gone into the sandy loam below, so that no reason could be assigned for the death of the trees.

The following interesting statements regarding the yield of the plantation is given in Major Van Someren's words:—

"The yield from material felled is entered in Chapter V, but it will be well to continue recording results per acre here, so as to compare them with the forecasts made in the report

for 1880-81. In that report the result of working compartment No. 1 was as follows for a rotation of 11 years:—

Area	Cubic feet stacked.
85·32	255,561
Outturn per acre	2,995
„ per annum	272
Equal to	68 maunds.

"It having been found by experiments that four cubic feet stacked, weighed almost exactly one maund after the fuel has been drying for some time.

"In 1881-82 clear fellings were made over 295 acres, resulting in an yield of 569,624 cubic feet. Then, comparing the two years, the result is that the average outturn for 1881-82 is only a little over 175 cubic feet.

Area	Cubic feet stacked.
295	569,624
Outturn per acre	1,931
„ per annum	175
Equal to nearly	44 maunds.

"For safety's sake the average of 272 cubic feet per acre per annum, was in the forecast reduced to 200. This was well, judging by the results of 1881-82 which are 175 cubic feet per annum, giving for the two years, 272+175=447÷2=223 cubic feet.

Various interesting experiments were made at Changa Manga to test the yield per acre felled under different systems, the would being cut into billets 5' and 2½' in length.

(*a.*) Cutting all trees at ground level.
(*b.*) Stubbing out all trees.
(*c.*) Cutting trees under 18" girth flush with the ground and stubbing out those over 18" girth.
(*d.*) The necessary labour and its cost for each system.
(*e.*) The proportion of the tree (in stubbed land) under ground, to its whole bulk.

"The result was that the saving in cutting flush was greater than the sum realized by the sale of the extra quantity of wood got out by stubbing. This, taken alone, would go to show that flush cutting should be adopted, but one experiment is not sufficient, and it is probable that the reproduction from stubbed roots will be larger and more sure. In experiment (*e*) the proportion was found to be about one-ninth."

A good deal of work has been done in the reboisement area of the Pabbi reserve in Gujranwala, respecting which we also give extracts.

Work began on the 30th June, and was continued till the 18th August to complete the area, 200 acres.

"The methods employed were—

(*a.*) A combination of trench and ridge, trenches of 1½ deep with the excavated earth formed into a ridge on the lowside, both ridge and trench being sown;

(*b.*) prepared lines, in which the soil was simply worked up, not taken out;

(*c.*) patches; refilled holes of 1 to 1½ feet cube;

(*d.*) mounds;

(*e.*) plough cultivation;

a and *b* were employed on the more level ground between the ravines;

c where *a* and *b* were impracticable, for instance on the slopes of the ravines;

d behind the bunds, often during the rains in standing water.

e on level ground, as an experiment.

"In addition to the above, Phulai (*Acacia modesta*) seed was sown on the sides of the bunds, and Sanatha raked in on the sides and top and on the sides of the ravines on rainy days, and scattered on every spot where there was any possibility of its germinating.

"The real task in places like Pabbi, where the rainfall is not only small, and distributed often over two or three months only, but where what does fall quickly runs off, is not simply to secure germination, which is comparatively easy in the rains, but to keep the seedlings alive after they have come up, when the dry season sets in, and to ensure success with a scanty as well as a plentiful rainfall. It was anticipated that the plan of sowing in the trench as well as on the ridge would effect this. It was thought that a heavy rainfall, beneficial to the seedlings on the ridge, might kill those in the trenches, and a light rainfall, insufficient for those on the ridge, might yet suffice for those in the trench. Both were not required, so that if either succeeded, it was all that was necessary. The result shows that the expectations in this respect were not without foundation. In some places the ridges have succeeded and the trenches failed; in others the opposite is the case, while in others again both have succeeded.

"The rainfall during the operations and up to the end of March was:—

June	...	2·6	Total 25·3 inches.
July	...	3·4	
August	...	10·6	
September	...	2·2	
October	...	0·3	
November	...	..	
December			
January	...	4·3	
February	...	1·4	
March	...	·50	

while, after the operations were concluded on the 18th August, the young seedlings only received 7·9 inches during 4½ months.

"The retaining dams in the ravines were kept in constant repair. During the season almost every one was breached once at least, and some more than once. Altogether 4,396 were repaired at a cost of Rs. 233. These dams are the most costly part of the cultural operations in Pabbi, and can never be carried out over the whole area.

"Reviewing the operations at the end of the year they must be looked upon as more than fairly successful; as yet they are far above the results obtained in any previous year, and are encouraging.

"The success is attributable :—

1*st*.—To careful supervision both on the part of the Divisional Officer as well as on that of Ghulam Muhammad, the Forester, under whose immediate charge the work was carried out, and who deserves credit for the result attained.

2*nd*.—To favourable rain at the time of sowing—a very important factor.

3*rd*.—To a plentiful use of seed.

4*th*.—To the methods employed.

5*th*.—To the action of the retaining dams.

"Of the methods employed the combination of trench and ridge has been by far the most successful. The prepared lines and patches failed after the drought set in. The mounds, where not washed away with the bunds, were exceedingly good, and have maintained themselves. Plough cultivation is the system on which previous operations have generally been carried out; it is cheap, but not reliable. The experiment, however, has so far succeeded very well.

"In the first instance everything germinated, and in August, September, and the early part of October the area was covered with millions of young seedlings in trenches, in patches, and on ridges, at distances of 6 to 12 feet apart. The small rainfall of September, 2·2 inches, and of October, 0·3 inches, coupled with the total failure of rain during November and December, soon, however, began to tell. The patches were the first to suffer, then the prepared lines, while seedlings in both ridges and trenches looked well, and are only now beginning to fail. This failure is partly also due to the ravages of a species of grub, which attacks the roots and gnaws them through, thus causing the death of thousands of young plants. Specimens have been kept for identification.

"The total cost of the operations has been Rs. 925, of which, as before remarked, the repairs to bunds form a large item, Rs. 233. Deducting this, the expenditure on simple sowing, preparation of the ground, collection of seed, &c., has reached only Rs. 692."

Regarding the yield of the forests the following extract from the Lieutenant-Governor's review will give sufficient details to interest our readers :—

"The number of trees felled by the Forest Department during the year was 5,840, of which 4,553 were deodar, nearly half of them from the Bashahr Division. The amount of timber received in the depôts was 497,000 cubic feet, or much the same as last year; but sales from depôt increased by 57,000 cubic feet. These figures do not take into account the large quantity of firewood and bamboos sold in the Rawalpindi, Lahore, and Beas Divisions. The balance of timber in the depôts at the close of the year consisted of 24,986 logs and pieces, containing 110,034 cubic feet; the number of pieces is larger than at the close of the previous year, but the cubic contents are more than one-fourth less. The scarcity of firewood at Rawalpindi has been brought to an end by the opening of the railway, which tapped the fuel supply of Kohat and Attock; and the sales from the Government depôt thus fell below those of the preceding year by 50,000 maunds. The result is satisfactory, for the resources of the rakhs in the neighbourhood of Rawalpindi were in some danger of exhaustion under the pressure of the great demand. There was a large falling off also in the amount of firewood removed by purchasers from the Mooltan rakhs, as the railway contractors were able to arrange with private persons for the supply of fuel on favourable terms. The number of sleepers imported from foreign territory during the year was considerably larger than in 1880-81; and though the number of deodar logs was less, the total amount of timber removed from the Government forests and imported from Native territory increased the general supply of available timber, and prices in consequence ruled somewhat low."

The following note of the Lieutenant-Governor's regarding free grants of timber in Kulu will also be of interest :—

"In paragraphs 12—13 of the Report, Major Van Someren has contrasted the free grants made in Kulu with those made in Bashahr, and arrives at the conclusion that for every eleven people who obtain a tree gratis in Bashahr, two people get one tree or more in Kulu. Without further examination the Lieutenant-Governor is not prepared to draw any inference from this comparison, and he observes that during the past year the free grants in Kulu have been reduced to 20,159 trees, whereas in the three previous years they always exceeded 30,000. In the recent orders regarding the demarcation of the Kulu forests, it was directed that registers of the free-grants made should be carefully kept up and checked from time to time, and this procedure should tend to prevent any unnecessary liberality in future. At the same time it must be remembered that, in such a matter as the free grant of timber,

the people of a country like Kulu, snow-bound in most parts for many months in the year, must be treated with all proper consideration.

"The financial results of the working of the Forest Department during the year have been satisfactory. The revenue realized was Rs. 16,629 more than in 1880-81; but as the expenditure of the Department increased by Rs. 20,902, the net income was Rs. 4,273 less than in the previous year, and amounted in round numbers to Rs. 1,72,000."

Progress Report of Forest Administration in South Australia for the year 1881-82.

This is the fourth of these annual reports which we have noticed in our journal, and it announces, at any rate, one great change as having taken place. This change is the resignation of the "Forest Board," and the impending introduction into the parliament of the colony of a bill to invest the control of the forests in the Commissioner of Crown Lands. We are sure that the change will be for the better, and that forest work will be facilitated by the larger powers given to the conservator.

The area of forest reserves has been increased by the addition of a small extent to that of Wirrabara, so that the total now is 239,336 acres, or about 375 square miles. To the plantations 1,425 acres have been added, so that the total area is now over 4,000 acres; and from the evidences given in this report there can be no doubt but that the South Australian Forest Department has been very successful in its planting work, the records of the different reserves and plantations showing a very considerable amount and success, and an evident great interest on the part of the officers employed in the work of restocking. Indeed the report is little but a record of planting operations, and there is almost no account of the work in the natural forests and of the effect of the pasture leases on them. We have already several times drawn attention to the "cart-before-the-horse" system adopted in South Australia, and the concentration of energies on planting to the probable neglect of work in the actually existent forests. The report gives some interesting information regarding the character of different species of *Eucalyptus*, and the soil and climate best suited to them. In plantation D. Bundolee reserve, *Eucalyptus rostrata*, from natural grown plants transplanted from the forest, has succeeded well in hollows of good soil; *E. corynocalyx* has shown itself best fitted for districts of uncertain rainfall; and *E. leucoxylon* has proved admirably suited for rough stony ground where some lime is present in the soil. Other species too have been successfully planted, but it is sufficient here to notice the above. Among exotic trees, perhaps the most noticeable success has been that

obtained with *Pinus insignis* and *Pinus maritana* in the Wirrabara reserve, both of these trees having, in spite of an unfavorable season, shown fine growth and extremely few failures. The *Catalpa*, cyprus and "bukayan" have also been successfully planted. In regard to the condition of the natural forests it is very satisfactory to learn that in the great Wirrabara reserve there is a large stock of mature timber capable of supplying a sawmill regularly. There was one in operation for a long time, but it has had to be removed owing to the railway it supplied being completed; but endeavours are being made to induce others to continue the work. During the year nearly 100,000 cubic feet of timber was obtained from this reserve.

Perhaps the most important information given in the report, now under notice, is that of the determination of Government to constitute reserves in the arid tree-less country in the north of the colony. Large reserves are to be found, and forests constituted partly by planting, partly by natural growth, in this area, and it may, therefore, be hoped that eventually the result will be the improvement of the climate, and the setting free from cultivation of a considerable extra area in what is now almost a desert. We quote the report on the subject written by the conservator Mr. Brown, as we feel sure it will be interesting to our readers:—

"GENTLEMEN—Agreeably to your resolution conveyed in letter No. 344 of 1881, I have the honor to advise having inspected the country north of Quorn, and now beg to report upon the subject of tree-planting there, for the information of the Hon. Commissioner of Crown Lands.

"In doing this I shall confine the application of my remarks to the country lying along the Coonatto and Quorn, and Quorn and Beltana lines of railway.

"The inspection made was necessarily a somewhat cursory one only; but the insight obtained of the natural features of the country was sufficient to enable me to express the opinion that, with care and under a systematic course of management, trees of certain kinds may be reared in the district with every chance of success. At present, with a few exceptions, the different parts of it are entirely destitute of timber available for the purposes of settlement, consequently farmers and others taking up the land, will, and do, labor under serious disadvantages in this respect. Again, the dearth of forest land in the district is undoubtedly the chief cause of the uncertain rainfall obtained upon it, and, therefore, considered in the light of an amelioration of climate alone, the providing of this by artificial means becomes an absolute necessity in order to promote this settlement.

"A due consideration of the whole subject resolves itself into the following recommendations:—

"1*st*.—All available lands along both sides of the railway

lines, as at present surveyed or fenced, should be declared forest reserves, and laid aside for forest culture only. Where the lines run through Hundreds not yet sold, or through unsurveyed country, the railway reserve to be extended on either side in suitable spots for tree-planting to a depth of at least thirty chains.

"*2nd.*—That every available piece of existing forest land, contained within the area embraced in this report, be at once declared a forest reserve, and put under a systematic course of conservancy. I use the expression at once because I consider that hitherto mistakes have been made in several instances in only placing timbered land under the Forest Department *after* the best trees have been removed from it, and serious damage done to its future reproductive capabilities; and, therefore, repetition of this is to be avoided, especially in the district under notice, where trees are the exception and not the rule. The most suitable spots of the kind indicated, so far as I could judge in a hurried examination, are as follows:—(1) The flat and hill of Cudlamudla, and from there along the range to Castle Rock and Yappala Hill. (2) The gums on Kanyaka Creek, near Black Jack, and brush timber in the Kanyaka hills. (3) The gums on Hookana and Mernmerna Creeks. (4) The gums on Moralana Creek. (5) Gums on Bunyeroo Creek. (6) Gums on Blackina Creek. (7) Trees on Blackfellow's Creek. (8) Trees on Breakfast-time Creek. (9) The Wilpena Pound, and all the forest country from Wilpena H. S. to a point a few miles north of Arkaba Station.

"*3rd.*—In addition to those just named, I have to advise that all the unsold lands lying along the Willochra Creek be proclaimed a forest reserve. A reserve along the Boolcunda Creek would also be of great service to the open agricultural lands in the Hundreds of Palmer and Boolcunda; but the practicability of carrying this recommendation into force will depend altogether upon whether the land along the creek is sold or not, about which point I have not been able to make myself acquainted.

"*4th.*—In establishing a system of land reservation for forest conservation and culture in the district under notice, it is most desirable, in order that the climatic influences to be derived therefrom may benefit it to the utmost extent, that so far as possible the reserves be laid off across the agricultural lands form east to west. Fortunately, as it happens, the natural drainage of most of the land embraced is in this direction, consequently the reservation of the indigenous forest lands as recommended will assist in this scheme.

"*5th.*—The reserves recommended along the Hookina, Mernmerna, Moralana, Bunyeroo, Blackina, and Blackfellow's Creeks, should be at least sixty chains in depth or breadth from north to south, and any bare or open land which may be included in this should lie on the south of the present timbered lands, in

order that the latter may be taken advantage of as a breakwind when forest culture or extension upon the reserves is resolved upon.

"6*th*.—The kinds of trees which I recommend for cultural purposes on the lands named are as follows:—*Frenela robusta* (native pine), *Eucalyptus leucoxylon* (S.A. blue gum), *E. corynocalyx* (sugar gum), *E. rostrata* (red gum), *E. hemiphloia* (box), *E. odorata* (peppermint), *Casuarina quadrivalvis* (sheaoak), *Fusanus acuminatus* (quondong), *Pinus insignis* (remarkable pine), *P. Pinaster* (cluster pine), *P. pinea* (stone pine), and *P. halepensis* (Aleppo pine). The first eight trees named are native ones, and should, at all times, be availed of most in preference to the other four kinds which should only be inserted on specially favorable spots.

"7*th*.—Owing to the uncertainty of the rainfall in the northern regions of the Colony, whereby any general system of planting trees out in the usual way would be very precarious and almost certain of failure, I have to advise that in putting land under trees on the reserves herein recommended, the system of sowing the seed broadcast on the ground, and waiting for the rain to come and germinate them, and nourish the young plants in nature's own time and way, should be largely depended upon in this district in connection with forest extension. To carry out this system successfully the ground would have to be ploughed and subsoiled to at least fifteen inches in depth, where this could be done, and afterwards summer-fallowed for a season before putting in the tree seeds. The ploughing would ensure a supply of moisture being obtained for the young plants, and the fallowing would clean the ground and prevent weeds interfering with the growth of the seedlings. For specially favorable spots—of which there are not a few—the young trees should be reared in a nursery, and planted out in the usual way.

"8*th*.—The scheme herein proposed for establishing a system of forest conservancy and extension in these Northern areas should, in my opinion, if it be undertaken at all, be begun at once; and the whole proposal carried out within a given number of years—say in ten years' time.

"Meantime I would advise that the reserves described should be proclaimed, and that 'experimental' plantations be started this coming season with blocks of the different kinds of trees named in two or three different spots, so that from the result of these experiments operations may afterwards be commenced upon the extensive scale recommended.

"For the present I would advise that the Mount Brown Reserve establishment be, with a little extension, the headquarters of the movement.

"To extend the establishment at Mount Brown, and institute the experimental blocks referred to, would cost about £500."

This report was approved by Government, and a sum of £500 has been placed in the estimates of the Department for the current year to carry out the experimental blocks recommended.

In order, however, not to lose what is likely to become a good season in the North, the Honorable the Commissioner has approved of an expenditure of £300 in anticipation of this vote, to begin the work during the present season.

Small experimental blocks have, therefore, been laid off, and are being operated on in accordance with the recommendations contained in the report.

The Financial results of the year were as follows:—

Revenue—		£	
Rents ...	...	... 5,495	
Timber	...	... 553	
Others	...	... 47	
		——	6,095
Expenditure—			
Establishments	...	... 4,872	
Others	...	... 957	
		——	5,829
		Total	£266

The large amount in Establishments, as compared with other expenditure, being due to the fact which we noticed last year of almost all the work being done by the regular staff.

Notes on Cinnamomum Cassia, and the vegetation of the West River.

By Charles Ford,

Superintendent, Botanical and Afforestation Department, Hongkong.

Dr. Schlich has kindly lent us a copy of Mr. Ford's notes on the *Cinnamomum cassia* which yields the Cassia Lignia of commerce. At the instance of Sir Joseph Hooker, who wished to identify the tree yielding the Cassia Lignia, Mr. Ford proceeded last May from Hongkong up the West river to the Cassia districts, whilst the trees were in flower. He brought back about 1,700 young Cassia plants, many of which are available for distribution to other colonies; but states that, like most of the order of Lauraceæ the seeds must be sown very shortly after they mature, as they rapidly lose their vitality.

The largest tree he met with was about 40 feet high, with a trunk about 3 feet in girth, and said to be 50 years old. He gives a complete botanical description of the species, and remarks that the bark, leaves, and incipient fruit "buds" of commerce taste strongly of cinnamon. The tree was nowhere

met with in a wild state, nor could any native be found who could tell where it grew wild.

Although still largely cultivated, it is said that the Java Cassia trade, in consequence of low prices, is crippling the China trade. An interesting account is given of the nurseries and plantations, the latter being always on hilly ground at altitudes from 300 to 1,000 feet above sea level and at all aspects. One and two-year-old seedlings are used for the plantations, and are put out at distances 3 feet apart.

The climate of the Cassia districts has a mean monthly temperature varying from 55° in January to 85° in July, and a monthly rainfall from 0 to 3 inches in December, January, and February, gradually increasing to from 15 to 30; in the five months, from May to September, the annual rainfall being between 66 inches and 111 inches. The climate thus resembles that of Assam, where Cassia cultivation would probably succeed. The first crop of bark is obtained when the trees are about six years old, the season for barking continuing from March till the end of May, after which the natives say it loses its aroma. The stems are cut close to the ground, and conveyed to adjoining sheds. Here all the small twigs and leaves being removed and taken off, the bark is stripped off in pieces 16 inches long and the epidermis separated from it by a small plane. It is then left to dry for about 24 hours, and then tied up in bundles ready for sale. The leaves are carefully preserved and dried, and yield Cassia oil. Cassia buds are really immature fruit, and, as well as the seeds required for the nurseries, are obtained from trees ten years old and upwards, which are left standing at distances from 50 to 100 feet apart amongst the stool shoots. Plantations of Cassia thus form a six years coppice with standards, and the yield is said to be about three dollars per acre per annum.

The value of the export from Canton in 1881 was about 450,000 dollars.

Mr. Ford's notes on the vegetation of the West river are very interesting, and we give them in his own words:—

"The West river proper is not reached until about 20 miles have been traversed from Canton by way of Fatshau along one of the waterways of the great delta. For this distance, and the next 15 miles of the West river, *i.e.*, as far as the Shui Hing Pass, the lands on both sides of the river is alluvial soil well cultivated. The first part has extensive tracts of rice fields surrounded with banks, on which are grown litchi, longan, and peach trees, with, at the base of the banks, the water cedar, *Glyptostrobus heterophyllus*. On approaching Fatshau the mulberry tree is met with in fields where it is grown for silk worm feeding. After passing Fatshau the rice fields are replaced with mulberry trees and bamboos, the land being higher than the river, and incapable of irrigation. On rising ground near the villages there are magnificent patches of arborescent

vegetation, consisting of *Ficus retusa*, *F. Wightiana*, *Fraxinus chinensis*, *Bombax malabaricum*, and bamboos. The Soy beam, (*Soja bispida*,) hemp, and the ground nut *Arachis hypogæa*, are cultivated on dry sandy soil. At forty miles from Canton the hills approach the river, and form the Shui Hing Pass. A few miles to the east of this Pass are the Ting U Shan woods which contain some splendid trees, probably upwards of 150 feet high. Amongst them were noticed *Bischoffia javanica*, *Cinnamomum parthenoxylon*, *Sterculia lanceolata*, and *Pinus sinensis*. Those woods surround a fine monastery, and are protected by the priests. The frutescent vegetation here consists of well-known plants that are common in South China. After passing the Shui Hing Pass the hills again recede and leave a large plain, on which, in addition to those plants mentioned as cultivated on the alluvial soil, the other side of the Pass, maize is grown in summer, and wheat in winter and spring. *Euryale ferox* is also grown for the sake of its seeds, which are used as food by the Chinese. After leaving this plain, the hills approach the river, and leave only a narrow strip on each side for cultivation. On the steep hills are some large patches of *Gardenia florida*, cultivated for its capsules, which furnish a dye used for dying silk. Near the Gardenia plantations are also some of *Machilus velutina*, grown for the sake of its bark, which contains a glutinous substance used in the manufacture of joss sticks. *Camellia oleifera* is grown on barren hills in the vicinity of some villages to supply the growers with oil for cooking and anointing their heads. It is not grown in sufficient quantities to sell.

A little above, a town called Fung Chun, over one hundred miles from Canton, the narrow strip of land on the south bank of the river is planted with bamboos, which are extensively used for boat poles and scaffolding. These plantations continued, with but slight interruption, for about the next 100 miles.

On both sides of the river the country is very mountainous, the hills rising from 300 to 2,000 feet, and with the exception of the level strips bordering the river, and a few patches on the hills of *Gardenia*, *Machilus*, tea plants, upland rice, and pumpkins are entirely destitute of cultivation. There is very little grass on the hills, but ferns (*Gleichenia dichotoma*) abound and cover the ground in every direction. The fern is cut and dried and used extensively for fuel; even the limestone in the lime kilns, which are numerous, is burned with this fuel only.

No forests are seen anywhere, but the Chinese are very careful to keep up, by annual sowing and planting, a stock of firewood, which however is confined to the common pine. *Pinus sinensis*, and instead of presenting the appearance of plantations well filled with handsome trees, they are planted irregularly and thinly over the hills, and have, in most

cases, but a miserable, stunted appearance, in consequence of the custom of continually cutting off the branches as they are required for fuel. Far up the river the *Cunninghamia sinensis* is found sparingly mixed with the pines, but this also never seems to attain a great size in the parts visited. *Cunninghamia* however, I was told exists in forests further north, and this report seemed confirmed by the enormous rafts of China fir logs, which were being floated down the river. The indigenous tree and shrub vegetation is continually destroyed, as it attempts to grow, by the deplorable custom of the Chinese in cutting down every branch and sapling for firewood, the *Pinus sinensis* being the only tree which they attempt to renew by planting. Round the villages and temples the trees are protected, and these examples, especially the Ting U. Shan woods, demonstrate the possibility of the Chinese mountainous districts producing splendid forests of a great variety of trees, if they were properly conserved.

No system of forestry seems to exist anywhere, the only efforts in that direction being the promiscuous planting and cutting of pines for firewood, this being done in the same way as on the mountain and islands near Hongkong—any one being allowed to plant where he likes, and the Government exercising no control over the people, in either planting or cutting down.

Fruit trees are only grown in small numbers dotted about near the houses, except the *Zizyphus jujuba*, of which a great many orchards were seen; they are on the level ground near the river, and the trees were planted at distances of about 20 feet apart. In addition to these, one orchard of litchis on a hillside was seen."

From Mr. Ford's description, we see that China is ahead of India in the matter of fuel plantations, and that doubtless the cowdung is put to its proper use as manure.

The Journal of Forestry and Estates Management.

THE JULY number has a novelty in the shape of two full-page plates—one showing the transformations of the stag-beetle (*Lucanus cervus*), and one a beautiful lithograph illustrating the growth of an old silver fir at Conishead Priory.

There is the first instalment of a paper on the "Conservancy of Forests in young communities," which is to be continued. It is no doubt true, as the author remarks, that "the inhabitants of our islands carry with them to the vast forest-covered plains and uplands of India, Australia," &c., "no knowledge of forestry which will enable them either to appreciate or rightly to use the wealth with which nature has so lavishly endowed them." But there is more than this. In England forests are so little a "climatic" necessity, and are so generally confined either to small (or even in some cases extensive) plantations

raised with almost *garden cultivation*, or else to parks, that the new-comer, even though he can appreciate the different operations of tree-gardening (if I may use the word), he is quite at a loss to know what to do with great masses of dense forest, or vast tracts of dry scrubby bush and jungle, so unlike anything he has seen before. This is painfully shown by the usually published papers on Australian forests, and on proposals to "do something" to save forests in America. We always hear of "planting trees" as the proposed solution. This of course is the remedy in a limited area and with a moist climate, but is soon dropped into the region of the impracticable in the countries in question. It is rare to find any one writing from England, that in such cases the true remedy is to set apart *large* blocks of forest, or even scrub (if there is no better) to be permanently placed under the protection of Forest law; still more rarely is it pointed out that such blocks must be studied, and after survey made (if the value is sufficient to demand that at once) a definite *plan of working* devised, based on a study of the contents, the rate of growth, and so on, so that a natural system may be relied on wherever possible, artificial reproduction being of course largely resorted to for particular species and in particular localities.

It is on this ground that we have to object to Mr. Sym Scott's paper which follows in the Journal. His experience and ideas being entirely confined to British parks and plantations, his criticism is rendered valueless by the fact that he knows nothing of Indian forests. What a good thing it would be if he could be taken through the Darjeeling Terai, then through the Garhwal deodar forests, then to the Melghat, then to Ahiri, and if he survived the leeches and other pleasures of the forest, to let him have a great ramble through the *Acacia modesta* (phulahi) jungles on the Salt Range and the "Rakhs" in the Panjab! He would then see how entirely, *de novo*, he would have to begin. How he would long, not only for neat-handed practice in pruning arboreta, and laying out ten-acre gardens of Scotch fir, with fence and padlock, but for some great principles of management, some plan of getting at the contents and yielding power of his estates—principles which, true in themselves, can be modified or rather, variously applied, to suit the different circumstances of the locality.

He would perhaps then come to feel how truly ridiculous, for *Indian forest training*, is the idea that the work can be done in class rooms at Cooper's Hill.

We observe at page 160, that Colonel Pearson has offered a most unnecessary apology for a phrase which is, and always was, perfectly true; there *are* in England neither foresters who can teach the science of forestry nor schools where it can be taught. But what Colonel Pearson might have added (if any one was so dense as not to understand that this was his meaning)

was, that the remark applied to such forestry *as is needed in India*. His defence as it is, is feeble. Eighteen years ago the practice of British forestry was very much what it is now and always will be. The subject of tree-planting may have been more or less in fashion, or more or less neglected; but not the smallest change (judging from the literature of the subject) has come over the views, the principles and the ideas, which underlie the British forester's practice.

The 'Journal' now takes as to new subjects. Those who have noticed the curious exudation of salt from the leaves of *Tamarix orientalis* will be interested in the next paper on salt in tree leaves.

Our readers will hardly need to be recommended to continue the perusal of Mr. McCorquodale's papers on "*Thinning* and *Pruning*" commenced on page 30 of this volume; a further instalment will be found at page 165.

Readers who wish for more facts about the influence of trees on climate will read with interest the extract at page 186, from Dr. Schomburgh's report on the Botanic Gardens of Adelaide (South Australia).

This number has also a review of Volume VII of the INDIAN FORESTER. We are always thankful for criticism, and even do not mind being scolded when our numbers are not all original! (though this is rather ungenerous seeing that we have not a paid editor, ample funds, and an English printing press, but that all the work is done by amateurs already fully tasked by their official duties and camp life.) As to the abuse heaped upon us in the matter of the Forest School, we care nothing for it. Not one word of sober argument has ever been adduced in reply to what we have urged. The English Journal, whenever it has replied at all, has simply strung together some lines of epithet, and has quietly ignored our main, and indeed only, position, *viz.*, that the circumstances of Indian forests are so utterly unlike those of the British parks and plantations, that no system of management, useful in the latter, is of more than partial use in the former. That a school of forestry *for* England is most desirable, we admit; but that it is impossible to teach in it forestry of such a kind as will be useful in India. We also required, as a subsidiary matter, that all forest officers sent out for the controlling staff, should be *gentlemen*—not in any fancy sense, but in the plain meaning of well educated men, such as in society of the best kind, are usually known as gentlemen.

To this the Journal has never condescended to reply except by abuse. If our reviewer will kindly refer us to any single paper in the "Journal of Forestry, &c.," where the matter is seriously reasoned and explained, and where it is shown that the theory and practice of English "forestry" *can* be sufficient for Indian requirements, we shall not only be grateful, but shall acknowledge his virulence to be at least excusable.

The AUGUST number opens with a notice of the memorial of the Society of Arts on a British Forest School. For once we find ourselves in entire accord with the Journal: the scheme is absurd. Why not at once create a good school for British foresters, to learn what will suffice in Britain, but leave Indian foresters to learn as the Indian authorities, who know what is wanted, desire?

The matter has however become inevitable; all we can do here is so to establish the reputation of our own Dehra Dun School, and so to develop its capacities, that we may train the students who will come out from the English school, and who of course will know nothing, but auxiliary subjects, that will be of any use to them in India.

But our contemporary should recollect that the State is chiefly to be moved to have a State school, when it has State forest officers to train. The Government may well reply 'we have no more to do with teaching *private* foresters than we have with any other profession. Private endowments have hitherto provided and maintained technical schools and colleges.' We think this open to answer; but so far it is a real objection to be met.

The paper on "Conservancy of forests in Young Communities" is continued in this number, and has here, we are delighted to see, recognized the *first* great point—the creation of State Forests. A lecture is reprinted, delivered by Mr. Boulger, at the Cirencester Agricultural College. Those who have learned forestry at Nancy will be somewhat doubtful about this writer's ideas of "Sylviculture."

Captain Roger's paper on "Plantations *without* thinning" will be read with interest, though many will fail to agree with him; *because* natural forests do without thinning, it does not follow that forests under human treatment will not be improved by it.

Indian foresters will hardly need to have the absurd misstatements of a paper signed "Veritas" pointed out. Colonel Pearson did not say that the controlling staff work with their own hands; if it comes to that, fire protection is done by coolies, not by officers, trained or untrained. What is obviously meant is that the very great progress made in the conservancy, and reproduction of forests, and in the revenue returns, since the introduction of educated officers into the department, is a proof of the success of the efforts hitherto made by the Government. It is not at all true that the improvement is due to the transfer of the income of one class of forests to our hands. The "Central Provinces" are not India; and if the author would take the trouble to refer to the Punjab, N. W. Provinces, Burma, Berar and above all to Bengal, he would find how very erroneous his conclusions are.

The SEPTEMBER number has a prettily illustrated paper on

"Autumn Leaves" which will be read by those who have the faculty of finding out and enjoying, the little bits of—romance we might almost say—that fall to the forester's lot, as a relief to the stern tasks of his official life.

Indeed most of this number is taken up with 'pleasant pages.' The paper on "American Forestry" (No. II) is however important.

There are also some very interesting remarks on page 348, on "Peculiarities of a great forest fire."

Reorganization of the Superior Staff of the Forest Department under the Government of India.

THE long-expected reorganization of the superior staff of the Forest Department has beeen carried out in the Government of India Circular No. 17F, dated the 20th November 1882, which has effect from the 3rd September. It is only for the provinces under the Government of India, and we shall be very glad to hear that the Madras and Bombay forest services have been as well provided for. We can only regret that it has not been thought advisable to increase the salary of the Inspector-General of Forests, so as at any rate to make it correspond with that of other heads of departments with the Government of India, as it is a post of great responsibility, and the expenses of living in Simla and Calcutta have to be taken into consideration.

In the resolution it is stated that consequent on the localization of the superior staff of the Forest Department, various readjustments in the grading of officers were necessitated, the most important of which was the temporary abolition of the grade of Deputy Conservator of Forests on Rs. 900 per annum. This grade has now been restored, and there will be four grades of Deputy Conservators instead of three, as will be seen from the following table, in which the scale of grading for forest officers is given :—

		Per mensem. Rs.
3	Conservators of Forests, 1st grade, on ..	1,500 each.
3	„ „ 2nd „ ..	1,250 „
4	„ „ 3rd „ ..	1,000 „
9	Deputy Conservators of Forests, 1st grade on	900 „
9	„ „ 2nd „ ..	800 „
17	„ „ 3rd „ ..	650 „
17	„ „ 4th „ ..	550 „
17	Assistant Conservators of Forests, 1st „ ..	450 „
17	„ „ 2nd & 3rd grades	350 & 250 each, respectively.

	Per mensem.	
	Rs.	Rs.
1 Deputy Director of the Forest School, rising by annual increments of Rs. 40 from	700 to	900
1 Professor of Natural Sciences at the Forest School, rising by annual increments of Rs. 40 from..	600 to	800
1 Superintendent of Working-Plans, rising by annual increments of Rs. 40 from ..	600 to	800
1 Deputy Superintendent of Forest Surveys, rising by annual increments of Rs. 40 from	600 to	800
Allowance to the Director of the Forest School		200
or a total of 100 officers arranged in the following classes :—		
Conservators		10
Deputy Conservators, including special appointments		56
Assistant Conservators		34
Total ...		100

The Director of the Forest School will still be Superintendent of Forest Surveys, though this is only a temporary and personal arrangement. Both the Superintendent of Forest Surveys, and the Superintendent of the Working Plans Branch, which has been newly established for the purpose of superintending the preparation of working plans in the several provinces under the Government of India, are placed under the control of the Inspector General of Forests.

Amongst minor provisions, we notice that an officer of the N. W. P. and Oudh list will be always attached to the Forest Surveys Branch, and an officer of the Burmah list will be stationed at the Andaman Islands.

The distribution of officers in the Provincial lists is as follows, and it will be noticed that there are now only five lists, and that the former subsidiary list has been broken up by attaching, forest officers in the Hyderabad Assigned Districts to the Central Provinces list, and by transferring the few remaining officers to other lists. The special appointments for the future are those of the Forest School, as well as the Superintendent of Working Plans, the Deputy Superintendent of Forest Surveys, the chief forest officer in Coorg, and the Assistant Comptroller of Forest Accounts ; and it is intended eventually that the two last appointments should be held by Deputy Conservators of the 1st or 2nd grades.

It is understood that the Deputy Director of the Forest School, and the Superintendent of Working Plans, will

be Professors of Forestry at Dehra Dun, though this has not been expressly laid down.

Provinces.	Conservators.	Deputy Conservators.				Assistant Conservators.			Grand Total.
		1st and 2nd grades.	3rd grade.	4th grade.	Total.	1st grade	2nd and 3rd grades.	Total.	
1. Bengal and Assam ...	2	3	4	3	10	3	4	7	19
2. North-Western Provinces and Oudh	3	3	3	4	10	4	3	7	20
3. Punjab	1	3	3	4	10	4	3	7	18
4. Central Provinces and Berar	2	3	4	3	10	3	4	7	19
5. British Burma ...	2	4	3	3	10	3	3	6	18
Special Appointments.									
Deputy Director of the Forest School.	...	1	...	...	1	...	...	...	1
Professor of Natural Sciences at the Forest School	...	...	1	...	1	..	...	...	1
Deputy Superintendent of Forest Surveys.	...	...	1	...	1	...	...	...	1
Superintendent of Working-Plans.	...	...	1	...	1	...	...	...	1
Officer in charge of the Coorg Forests.	...	1	...	...	1	...	...	...	1
Assistant Comptroller General (or Assistant to the Inspector General of Forests.)	...	1	...	...	1	...	...	...	1
Total ...	10	19	20	17	56	17	17	34	100

As the number of Deputy Conservators in the 1st grade is only 9, it has not been found practicable to allot these appointments among the local lists, and promotion to this grade must remain with the Government of India. Only the total number of the 1st and 2nd grade Deputies has been entered in the distribution list. The following table shews the present distribution of Deputy Conservators of the 1st and 2nd grades amongst the several provinces :—

Provinces.	Deputy Conservators.		
	1st grade, appointed by the Government of India.	2nd grade, *to be* appointed by Local Governments	Total.
Bengal-Assam	1	2	3
North-Western Provinces and Oudh	1	2	3
Punjab	3	...	3
Central Provinces, Berar ...	2	2*	4
British Burma	1	3	4
Government of India	1	...	1
Total	9	9	18*

* One of these two appointments remains only temporarily on the Central Provinces Berar List, as stated in paragraph 5 of this Resolution.

Local Governments are invited to settle the appointments up to and including that of Deputy Conservator 2nd grade, but appointments to the rank of Conservator and to the special offices, as well as, for the present, those to the 1st grade Deputy Conservator, will be made by the Government of India.

As Mr. Baden-Powell's Manual of the Land Revenue System and Land Tenures of British India is now ready, it is ordered that after the 1st April 1884 no officer will be promoted permanently to the rank of Assistant Conservator of Forests, 1st grade, who has not qualified in the land revenue of his province; and in case the Manual on Forest Law should be published before the 1st April 1883, qualification in the elements of law will also be enforced from the 1st April 1884; but if the law manual be not ready in time, this condition will be held in abeyance for a corresponding period beyond the 1st April 1884 so as to give the officers one full year for the study of the subject after the publication of the manual.

In order to encourage as much as possible the study of the above subjects, Local Governments are requested to take into consideration the fact of officers having qualified in them, on filling up vacancies in the 1st grade of Deputy Conservators.

The resolution ends with two clauses, the former of which rescinds rewards for passing in compulsory languages, and the latter subordinates the Forest Survey and the Working Plans Branch to the Inspector General of Forests, but it is to be hoped that the head quarters of both will remain at Dehra-Dun, in connection with the Forest School.

Revised rules regarding the appointment, promotion, &c., of officers of the Forest Department are appended to the resolution, but do not call for any particular remarks. The superior staff of the Forest Department, under the Government of India, is now on a liberal and permanent footing, with the single exception which we have noted; and, if the pension rules can be improved, some general provision made for deductions from officer's pay, both for their own pensions, and for the maintenance of their families, in case of death, we shall have every reason to be contented.

III. Timber Market.

PRICES CURRENT IN OCTOBER.

Rangoon Teak.

Mast Pieces, good large	... Rs. 5 to 12 per running foot	...	Quotations nominal.
Ditto, small	... „	...	
Sawn Timbers ...	... „ 80 to 105 per ton	...	Ditto.
Planks, long lengths	... „ 115 to 125 do.	...	Ditto.
Sheathing Boards ½ inch	„ 115 to 125 do.	...	
Ditto ¾ inch			
Boards 1 inch...	„ 105 to 125 do.	...	

Moulmein Teak, &c.

Square Timbers, 20 to 29 feet long, 10 to 13 inches square, first-class	Rs. 90 to 120 per ton of 50 cubic feet.
Ditto, 20 to 45 feet long, 14 to 18 inches square	... „ 120 to 175 do.
Second-class Timber ...	... „ 90 to 98 do.
Planks, long lengths, first-class	... „ 115 to 125 do.
Furniture Planks, 18 to 36 inches broad, and 1 inch thick—good	... Rs. 130 to 170 do.
Sheathing Boards, ½ inch, double,	... „ 135 to 140 do.
Ditto, ¾ inch	... „ 110 to 140 do.
Mast Pieces ...	... „ 0 to 0 per running foot.
Scantlings (of sizes) ...	... „ 130 to 165 per ton.
Moulmein Cedar Square Timber	... „ 65 to 70 „
Thingan and Consohr	... „ 45 to 50 „ Nominal.
Agilwood	...
Peemah	... „ 55 to 65 „

American and Colonial Timber.

Mahogany ...	As. 6 to 0 per supl. foot of 1 inch thick.
Ash Oars	„ 5½ to 6 per foot
Sal small ...	Rs. 70 to 110 per ton.
Ditto large ...	
Johore Teak Squares ...	„ 60 to 0 per ton.

PRICES IN BOMBAY DURING OCTOBER.

Bamboos	per 100	...	...	Rs.	16 9	8
Charcoal	„ maund	...	...	„	2 1	9
Firewood	„ „	...	...	„	0 10	9
Teak Timber	„ „ ...	...	...	„	2 14	10
Jungly Timber	...	...	...	„	1 13	3

PRICES AT BYRAMGHAT IN OUDH.

Sal Beams, per cubic foot	...	...	Rs.	2 10	Rs.	3	0
Scantlings „	...	...	„	2 0	„	2	8

PRICES AT KURSEONG.

The rates at present in force for the sale of timber and other forest produce from the forests and depôt of the Kurseong Division are as follows :—

Depôt Sales.

Group	Julpigoree and Siligoree Depôts. Class 1.	Class 2.	Class 3.	Sukna and other Depôts. Class 1.	Class 2.	Class 3.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
A ...	1 8 0	0 12 0	0 8 0	1 4 0	0 10 0	0 5 0
B ...	1 4 0	0 10 0	0 5 0	0 12 0	0 6 0	0 3 0
C ...	1 0 0	0 8 0	0 4 0	0 8 0	0 4 0	0 2 0

Group A includes sal.
„ B „ saj, toon, champ, chilauni, sissu, kimbu, malagiri, gambari
„ C „ all other kinds
Class 1 contains logs which are large, straight, and sound.
„ 2 „ „ „ „ smaller, or which though large are not quite straight.
„ 3 contains short pieces chiefly.

Forests Sales.

	Standing trees each. Rs.	Dry wood per cubic foot Rs. A. P.
Group A ...	25	0 5 0
„ B ...	20	0 4 0
„ C ...	15	0 3 0
„ D ...	10	0 2 0
„ E ...	5	0 1 0

	Each. Rs. A. P.
Poles, groups A and B—	
Under one foot girth at four feet from big end	0 2 0
One to two feet girth at four feet from big end	0 8 0
Two to three feet girth at four feet from big end ...	2 0 0
Three to four feet girth at four feet from big end	4 0 0
Groups C, D, E, half the above rates.	

Group A cantains toon, champ.
„ B „ sal, oak, chestnut.
„ C „ saj, panisaj, lampatia, semul, sissu, chilauni, gambari, mandania, kimbu, kainjal, mainakat, malagiri, saner, gazuldhup, gobria, lali, kawala.
„ D other trees which usually reach six feet girth.
„ E small trees which do not usually reach six feet.

The annual sales of forest produce in the Kurseong Division, British Sikhim, are already systematised, as will be seen from the subjoined notice, which will excite the envy of Divisional Forest Officers in less favored localities where there is a difficulty in disposing of all kinds of forest produce.

We hope that the Kurseong Divisional Officer will kindly favor us with a note as to the results of his sales.

Notice.

Offers are invited for the purchase of forest produce in the undermentioned forests of the Kurseong Division, situated in the lower hills, and the Terai of the Darjeeling district, being the compartments appointed for working during the season of 1882-83.

For situation of the forests and blocks see new map of Darjeeling District, 1879-81.

Range.	Forest.	Block and compartment.	Description of produce.	Area of cutting.	Remarks.
Kurseong...	Dhobijhora.	.....	About 3,000 maunds of firewood ready cut and stacked at the side of the Central Forest road.	.....	Tenders invited.
		Compartment 8	About 125 trees fit for scantling, and about 60,000 maunds of firewood, chiefly oak, magnolia, chilauni, gobria, &c	62A	Tenders for the whole amount preferred. Suitable for planter's firewood or charcoal.
	Babookhola.	Babookhola block	Dry and fallen trees for firewood or charcoal.	.....	Rate Rs 4 per 100 maunds, to be cut and stacked by the purchaser previous to measurement.
Bamunpokri	Bamunpokri	Whole ...	Bamboos, about 7,000.	.....	Tenders invited. Last year's tenders were accepted at Rs. 5 per 100.
		,, ...	Thatch grass ...	.....	Tenders invited per 100 bundles.
	Lama Gumba	,, ...	Bamboos, about 5,000.	.....	Tenders invited Last year's tenders at Rs. 3 per 100.
	Bamunpokri	Block IV, compartment 2.	About 80 trees fit for scantling, and about 50,000 maunds of firewood chiefly chilauni, saj, sidha, and similar trees.	30A	Tenders for the whole amount or per 100 maunds stacked firewood preferred. (A carting road now passes through this compartment.)
		Rapti block ...	Thinnings and dry wood, chiefly khair and siris.	20A	
		Bamunpokri block I.	A number of poles of sal, teak, and other woods of various sizes.	.....	Will be cut departmentally, and sold by auction in spring of 1883.
Balasan ...	Dulka Jhar.	Khadma block (north-west corner of forest).	Improvement thinnings, and dry wood for fuel. Also some sal poles of various girths.	250A	Tenders invited per 100 maunds of stacked firewood; purchaser to cut. Poles at departmental rates.
	,, ,, ...	Harlia block (south-east corner of forest).	Improvement thinnings, and dry wood for fuel Also some sal poles of various sizes.	309A	Ditto ditto.
	Jukria Jhar	Compartment 1.	Improvement thinnings	45A	Ditto ditto.
	Marijha ...	Khairbarri block	About 5,000 bamboos.	.....	Tenders invited.
		Lohagarhi block,	About 2,500 bamboos.	.....	Ditto.
		Manjha block.	About 8,000 bamboos.	.....	Ditto.
		Manjha block, compartment 1.	Improvement thinnings of badly shaped trees, closely grown kinds, and extraction of dry wood.	140A	Tenders invited per 100 maunds of stacked firewood; purchaser to cut.
	Mechi ..	All blocks ...	Dry and fallen wood.	.....	Including drift wood of Mechi river.
	Pantapari.	Ditto ...	Ditto ...		South-east of Tirihana-hat.
Sukna ...	Sukna .	Ditto (between Kooklong and Panchenai rivers).	Bamboos, about 10,000.	.....	Tenders invited per 100 standing (Last year's tenders accepted at Rs. 3-8 per 100).

Range.	Forest.	Block and compartment.	Description of produce.	Area of cutting.	Remarks.
	Sukna ...	All blocks ..	Thatch grass ..	.....	Tenders invited per 100 bundles
	,,	Kynanooka, compartment 2.	Improvement thinnings as in 1881, and dry wood will probably give about 25,000 maunds firewood, and a number of sal and other poles.	.....	Tenders invited per 100 maunds stacked firewood to be cut by the purchaser. Poles at departmental rates
	Mahanadi..	All blocks (between the Panchanai and Mahanadi rivers)	Bamboos, about 10,000	.....	Tenders invited per 100 standing.
		Pundig block...	Dry and fallen timber for firewood and charcoal	.....	Rs. 4 per 100 maunds. Cut and stacked firewood, cut by purchaser
	Rest of range.	....	Dry wood and bamboos, also thatch grass.	....	Departmental rates.

All tenders must reach the office of the Assistant Conservator, Kurseong, before the 25th October 1882, marked on the envelop "Tender for purchase of forest produce." The Assistant Conservator will open the tenders and decide which to accept; and his decision, which will be communicated to the parties tendering before the 31st October, will be final.

With the sanction of the Conservator, 10 per cent. of the purchase money shall be paid on intimation of acceptation of tender, and the balance, not later than the 28th February 1883. The 10 per cent. deposit shall be paid to the range officer concerned, viz.—

The forester	at	Dhobijhora	for	Kurseong	range.
,, ,,	,,	Bamunpokri	,,	Bamunpokri	,,
,, ,,	,,	Sukna	,,	Sukna	,,
,, forest ranger	,,	Panighatta	,,	Balasan	,,

The selection and marking of the standing trees, permitted to be cut in the different blocks worked, will be made as early as possible, after the 1st October, by the Assistant Conservator and range officers, and no trees, poles, saplings or seedlings not so marked may be cut. The sale of standing trees on permit will still continue as before, at the departmental rates in force; as will also the sale of grass, canes, and other minor produce, as well as of bamboos from the forests not especially mentioned.

Regular thinnings have been started in the Dehra Dun forests, the trees being marked in the hot season, and sold by public auction in the following September.

This year 2,922 sal and 821 sain trees were sold at Rs. 2-9 each.

The trees are inferior, and mostly unsound at the base.

For selected standing sain trees 8 to 10 annas a cubic foot is procurable in the forests; and there is a great demand for this class of timber which sold last year on the Ganges, above Hardwar, at 14 annas to 1 rupee per cubic foot.

There is also a large demand for scantlings of *Bakli*, *Karar*, and other trees, for which 3 to 4 annas per cubic foot is readily paid in the forests.

We shall be very much obliged if Divisional Forest Officers would furnish us from time to time with the prices at which timber is selling, at different places, for the purpose of comparison.

The following extract from the *Timber Trades' Journal* shows that mahogany is getting scarce in the English market. We should like to know of what quality is the timber of the fine mahogany trees grown near Calcutta; and whether mahogany cannot be planted out on a large scale in Lower Bengal and Burmah:—

"Tabasco mahogany logs are getting scarce. There are some Honduras and Mexican logs on the market, but very little Tabasco wood is to be found, and what there is, is mostly small-sized. At the Liverpool auction sales of mahogany the buying appears to have been a good deal confined to country consumers, merchants doubtless deeming it too risky to bid up to the figures at which the lots were knocked down."

The following will also be interesting:—

"By-the-bye, what quaint-looking little crafts they are which bring over mahogany logs; the sailors dressed in their blue cotton suits, with their sunburnt, brown complexions, the vessel schooner-rigged and rakish-looking, the long bamboo canes or poles lashed to the bulwarks, the bunches of bananas hung out in the sun to ripen, the valuable little cargoes, each and all look thoroughly tropical, and are, as a rule, the most interesting objects to be found in the docks.

"The demand for Swedish and Norwegian whitewood ends for wood pulp making is greatly on the increase, and will doubtless, ere long, develop into an important branch of the timber trade. When once the business is started, the demand is heavy and continuous. Some of the latest American wood pulp-making machines consume an enormous quantity of whitewood ends, and they are spoken of as being well planned for the work. Redwood does not make good wood pulp, it being next to impossible to produce paper of a good colour when the pulp is made of redwood. The ordinary Swedish and Norwegian whitewoods, however, are said to answer the required purpose admirably."—*Timber Trades' Journal.*

THE Session of the Dehra Dun Forest School for theoretical work closed on the 31st October 1882, and the following is the list of Marks gained by Students :—

	NAMES.		Marks gained at Monthly Examinations.	MARKS GAINED AT FINAL EXAMINATION.							Grand Total.	REMARKS.
				Botany.	Mathematics.	Physical Science	Theoretical Forestry.	Forest Law.	Surveying.	TOTAL.		
	Second Year's Course. Full marks ...		900	360	240	360	600	240	...	1,800	2,700	
1	Moti Singh	Punjab	799	336	144	360	500	193	...	1,533	2,331	Ranger's Certificate, and Prize value Rs. 40.
2	Daulat Ram	Do.	774	264	128	326	470	240	...	1,428	2,202	Ranger's Certificate, and Prize value Rs. 30.
3	Kripa Nath Dey	Assam	580	144	96	218	320	176	...	954	1,534	Ranger's Certificate.
4	Chunder Kumar Chatterji ...	Central Provinces ...	815	312	*a*	*a*	*a*	*a*	...	312	1,127	Prevented by sickness from attending examinations. Certificate of eligibility for the class of Sub-Assistant Conservator.
	First Year's Course. Full marks ...		780	360	240	360	600	...	900	2,460	3,240	
1	Jogeswar Sur	Assam	715	360	192	360	600	...	710	2,222	2,937	
2	Mahadeo Rao Palsaitkar ...	Central Provinces ...	651	336	144	312	600	...	818	2,210	2,861	
3	Charles Ingram	British Burmah ...	655	240	224	260	600	...	770	2,194	2,849	
4	Havildar Sadhu Singh ...	Punjab	685	336	160	312	460	...	834	2,102	2,787	Prize in Surveying, value Rs. 30.
5	Rama Nand	Do.	645	336	96	360	580	...	765	2,137	2,782	
6	Roghu Nath Pathak ...	Oudh Circle	589	336	144	312	540	...	813	2,145	2,734	
7	Sundar Lall	Patiala State	598	312	48	336	580	...	834	2,110	2,708	Prize in Surveying, value Rs. 30.
8	Kedar Nath Muzumdar ...	Bengal	541	360	96	288	600	...	785	2,129	2,670	
9	Dino Nath Kar	Assam	593	288	128	216	580	...	783	1,995	2,578	
10	Gulam Mohomed	Punjab	544	264	112	312	360	...	773	1,821	2,365	
11	Tiu Kari Choudri	Bengal	535	288	128	144	400	...	788	1,748	2,283	
12	Gurdit Singh	Kapurthala State ...	548	216	64	336	400	...	708	1,724	2,272	
13	Moung Shuay Kah ...	British Burmah ...	507	240	48	264	360	...	780	1,692	2,199	
14	Bhusau	Berar	528	168	32	264	320	...	790	1,574	2,102	
15	Ram Narain	School Circle	367	144	80	240	240	...	625	1,329	1,696	
16	Moung Thakadoe	British Burmah ...	314	144	...	120	300	...	783	1,347	1,661	
17	Moung Hapy	Ditto ...	241	96	...	192	340	...	710	1,338	1,579	
18	Moung Htoon	Ditto ...	336	96	32	120	200	...	783	1,231	1,567	
19	Nanak Chand	School Circle	337	72	32	144	160	...	613	1,021	1,358	

TREE PRUNING.—*(Translated from the French of A. des Cars, by Charles Sargent, Professor of Arboriculture in Harvard College, U. S.)—Aim and Method of Pruning.*—The object of pruning, economically considered, is to make it possible to raise, on a given surface, say on one hundred acres of sprout land, the greatest number of full-grown trees, and to make them attain the greatest value in the shortest time without injury to the young trees beneath them. This may be accomplished by increasing the vigour of the reserve trees, and by lengthening, without diminishing in diameter, their trunks. Treated in this manner the reserve trees do not interfere with the circulation of air and light necessary to the development of the undergrowth; and many serious accidents caused to trees by wind, frost, and snow breaking the larger branches may be avoided by keeping their heads symmetrical and upright.

The perfect forest tree has a straight, single trunk, without protuberances or wounds, and carrying up the same diameter to the first branches, which should be placed at a distance from the ground equal to one-third or one-half of the total height of the tree. The head should be rounded regular, and set upright on the trunk. The wood, owing to the healthy growth of the tree, is straight-grained, compact, and suitable for construction. Such trees have a high value; and, in order to grow them, a method of pruning is adopted similar to that practised by gardeners in forming pyramidal fruit trees, with the difference, however, that the gardener favours the development of the lower branches, which are necessary for his purpose, while the aim of the forester is to increase foliage at the top of the tree by diminishing the vigour of the lower branches; and to obtain, by successive suppressions of branches, the necessary length of trunk.

There are two distinct operations in pruning: the removal of some branches, the shortening of others. The shape of a tree must depend somewhat, of course, upon its age, the nature of its surroundings, and the character of the soil, &c. Where pruning is not practised, the reserve trees approach the proper form in proportion to the length of time the coppice beneath them is allowed to grow. In forests, where thirty or more years are allowed to elapse between the cuttings, the undergrowth serves to prune the permanent trees by checking the development of their lower branches, and thus determining the height of their trunks. Sprout land is, however, often cut over every ten years; and this practice prevents the production of fine trees by permitting the growth of their lower branches. These, of course, interfere with the growth of the reserve trees themselves as well as with the young trees between them. Judicious pruning can obviate this difficulty.

Classification of forest trees according to age.—The technical

names by which reserve trees are known vary in different regions. For our purpose it will be best to divide the life of a forest tree into four principal periods, designated as follows:—

(1.) Young, up to about forty years.
(2.) Middle-aged, from forty to eighty years.
(3.) Old, from eighty to one hundred and fifty years.
(4.) Very old trees, whose number is rapidly diminishing may be called veterans.*

These divisions are not, of course, absolute, as it is often difficult to determine, even approximately, the age of a standing tree; and the forester must use considerable judgment in the application of the following rules:—

1. The head of the young tree should be egg-shaped or elongated oval, and well balanced on the trunk, which should not exceed a third of the entire height of the tree. The lower branches should be sufficiently shortened to check their excessive growth at the expense of the leader, without, however, being so reduced as to impair the vigour of growth of the tree.

2. The head of the middle-aged tree should form an oval less elongated than that necessary for trees of the first class. The height of the trunk should equal one-third to two-fifths of the height of the tree.

3. The head of the old tree should be gradually rounded in outline; the trunk may, in some cases, be made to reach a height equal to half the height of the tree which has now probably ceased to grow upwards.

4. *Veterans.*—Trees classed as veterans have generally ceased to increase in size. They gradually become flat-headed, and spread out, without, however, greatly injuring the adjoining coppices and plantations destined to take their places.

The proper method of pruning trees in each of these four divisions will be considered hereafter.

It is well to remember that the forms recommended are those nature gives the most perfect and most beautiful trees; although it is the most economic and not the picturesque aspect of trees which is here under consideration.

Tools used in Pruning.—The most convenient tool for pruning is a straight-bladed cleaving knife. Success in all operations of pruning depends on the neatness of the cut, and this cannot be attained with the common billhook used in many

* The technical terms employed in France to designate trees of the four classes into which forest trees are generally divided, *baliveau, moderne, ancien and vieille ecorces*, have no equivalent as yet, and are not well translated into English. The term "Baliveau" is also sometimes applied to reserve trees of any age left after the first cutting off of a plantation, and such trees are then called "Modernes," or "Anciens" according as they have been allowed to remain after a second or third cutting of the coppice.—C. S. S.

parts of France. The best tool for the purpose is one which has been used for many years in Holland, and which has lately been improved by de Courval. It weighs from 2lb. 12oz. to 3lb. 6oz., or more, according to the strength of the workman. The blade is reinforced in the middle to increase its strength and concentrate the weight. In the north of France this tool is generally hung to an iron hook attached to a leather strap buckled round the workman's waist, who is thus left perfectly free in his movements.

In pruning tall trees, or trees, otherwise difficult to climb, the leather belt may, with advantage, be passed over the shoulder, thus bringing the pruning knife under the arm in a position from which it cannot easily be dislodged in climbing. To insure greater safety in climbing tall trees, a stout cord attached to the workman's waist, may be fastened round the trunk in such a manner as to prevent, in case of accident, a dangerous fall. A hatchet is useful, and facilitates the operation of pruning; it may be used with one or both hands, and serves to lop off large branches, protuberances on the trunk, or the dead stumps of branches, which, from their hardness, would soon dull the edge of the best pruning knife. A saw, too, is very useful in cutting large branches, but it requires so much practice to use this tool skilfully that it cannot be generally recommended.

Ladders.—Each labourer should be equipped with a light ladder, proportionate to the height of the tree on which he is to operate, and broader at the base than at the top. De Courval recommends that the feet of ladders, intended for this purpose, should be pointed to prevent them from slipping. This is a good plan, although hardly sufficient to prevent accident, and the top of the ladder should be fastened with a strong rope to the trunk of the tree to prevent it from being thrown down by falling branches.

Hooks or Spurs.—Except in very exceptional cases, or where very large trees are to be operated on, the climbing spurs, sometimes used by professional pruners, should not be allowed. These men, paid according to the number of trees operated on, or the quantity of wood cut, have no idea in pruning beyond cutting the largest amount of wood in the shortest time. Climbing spurs should never be used by good workmen even in pruning young trees, whose bark is not sufficiently thick to resist the wounds caused by the sharp iron teeth of this tool. Wounds made in this way encourage the growth of injurious side shoots on the trunk, and leave defects in the wood which never disappear, and diminish its value.

The future value of a tree depends upon the manner in which the operation of pruning has been performed; and the persons to whom this work is entrusted should fully understand its importance. Unskilful or injudicious pruning may com-

pletely ruin a tree, and the difficulty of obtaining labour capable of doing such work intelligently, causes, no doubt, many arboriculturists to completely neglect pruning of every kind.

The Dendroscope.—The tree requiring pruning should be carefully studied from the ground, that the operator may be able to judge intelligently which branches should be removed or shortened in order to reduce it to the desired shape. This may at first seem difficult to beginners in the art of pruning, and a dendroscope, the name suggested for a simple little contrivance, may be here used with advantage. A dendroscope may be made from a piece of thin board or cardboard (a playing card answers the purpose), in which a hole of the shape it is desired to reduce the tree to has been cut. Across the middle of the hole, from top to bottom, a piece of fine wire is stretched to serve as a guide to the eye.

Holding the dendroscope at the level of the eye, with the wire opposite the centre of the trunk of the tree to be studied, the operator approaches the tree until the bottom of the cut falls on the trunk at the ground line. It is easy to see at a glance, with the aid of this contrivance, what operations should be performed in order to reduce the tree to the desired shape.

Remembering that under ordinary circumstances a vigorous, handsome tree must have a straight, vertical trunk and an evenly-balanced head, the first object of pruning should be to produce these conditions. The head, as has already been explained, should be oval in form; the height of this, however, must depend on the size of the trunk and the age of the tree when first subjected to the operations of pruning.

Selection of the leader.—The branch most nearly perpendicular on the trunk of the tree should be selected to form the leader; and it may be stated as an absolute rule that *whenever a branch near the top of the tree stands vertically on the trunk, or even on any part of the trunk, it should be preserved for the leader.*

And it is wrong to suppose that only the original leader can be used. Its place may be often supplied by one of the lateral branches even; and by shortening the other branches to stimulate the growth of the new leader, the tree will, in a few years, straighten up in a manner which will appear astonishing to persons unfamiliar with the results which may be obtained from a sensible system of pruning.

If none of the branches near the top of the tree naturally approach a vertical position, two or three or several branches should be preserved to form a compact head. If the tree so treated is young, it is desirable, if possible, to establish the fork at a distance from the ground equal to at least one-third of the height which the tree may be expected to attain at maturity.

Shortening main branches.—Starting from the top of the tree, where the operation of pruning should always begin, the leader is first formed with the branch selected for this purpose; the head is made with a single leader; or, in case of necessity, with several leaders. The principal branches, if too long; should then be shortened, especially those inclined to assume a vertical position or to grow with too great vigour at the expense of the leader; such branches are called gourmands. It will be seen that the right point at which to shorten these vertical branches is the point where they begin to assume an upright growth.

In shortening branches, the cut should, if possible, be made above the point of development of one or several secondary ascending branches; these in turn should also be cut just above one of their secondary branches. In this way the direction of the main branch may be entirely changed, and its disproportionate vigour checked to the benefit of the leader and the whole tree.

Sap Lifters.—The name sap lifter *(Branche d'appel)* may, for want of a better term, be given to the branch or branches retained at the end of the shortened main branch. The name indicates the object for which such branches are left; namely, to attract and elaborate, by means of their leaves, a sufficient flow of sap to ensure the growth of the branch. Sometimes the main branches are so long that it is impossible for the operator to reach the ends where the sap-lifting branchlets should, of course, be left. In the case of the oak, such branches, except for the appearance of the tree, are of little importance; and provided the main branch retained is of a certain length (ten or twelve feet), and, if it is large and on a large healthy tree, a sufficient number of new shoots to ensure vigorous growth will soon appear. With the beech, however, and some other trees which do not develop shoots from dormant buds as freely as the oak, it is necessary to cut the branch just above the forking of another branch or branchlet large enough to attract sufficient sap to ensure a healthy growth.

Double or Forking Branches.—In the case of a double branch, or of a branch forking close to the trunk of the tree, one of these branches should always be removed, that the base of the branch may not become disproportionately large. If, however, such double branches are objectionable near the trunk of the tree, they are of great importance at the extremities of main branches; and whenever it is possible branches should be shortened in such a manner as to secure forking branchlets at their ends. These give to the tree a more natural appearance, and by dividing the flow of sap prevent the growth of too vigorous shoots, which might, in time, develop into supple-

mentary leaders, to the injury of the tree. For this reason it is necessary to remove all branches or branchlets assuming a vertical growth or inserted on the upper side of a shortened branch, in order to check the tendency of such branches to grow too vigorously at the expense of the leader.

Although essential in pruning young trees, this is less important in the case of older trees with large full heads which, in themselves, have a tendency to check an unnaturally strong growth of any individual branch; and in operating on old trees the preservation of vigour in the shortened branch is the principal object to be attained. It is almost unnecessary to add that only main branches, directed towards the outside of the tree, should be preserved, and that branches which, from any cause, have turned back towards the trunk, should be headed in, as well as branches with too great a tendency to droop unnaturally; generally, it will only be necessary to shorten such branches to induce them to re-assume a natural direction of growth.

When several branches have been developed from one node, forming what botanists call a whorl, they should not all be cut away at the same time, lest the circulation of sap be checked by the destruction of bark (and consequently of cambium layer) over too large a surface.

All dead and dying wood should be removed by the workmen in descending the tree; lichens, and other parasites which interfere with the growth of young trees, should be knocked off with the back of the pruning knife; and the mistletoe, the most destructive of all parasites to tree life, should be carefully removed by cutting off the branch bearing it.

The necessity of commencing the operation of pruning at the top of the tree must be insisted on; in no other way can the form proper to the tree be established or the safety of the operator preserved. The disregard of this rule was followed not long ago by what might have been a severe accident. An excellent workman was about finishing the pruning of a beech tree; two long, slender branches remained to be operated on. He cut the lower of the two branches first; the twigs on the ends of the branches had become interlocked, and the branch B. in falling, pulled down the branch A. This broke under the weight of the first, and, striking the operator on the head, inflicted a severe wound, causing his fall to the ground, a distance of twenty or thirty feet.

The Amputation of Large Branches.—Many of the lower branches, previously shortened, must afterwards be removed, from time to time until the necessary height of trunk has been attained. The number of branches to be removed must, of course, depend on the height of the tree, the nature of the soil in which it grows, and its age when first operated on.

Great caution should be observed in amputating large branches; small branches can, of course, be lopped off at any time without danger to the tree. We agree with de Courval that at least three medium-sized branches may be safely removed from a tree in one year, although if the branches are very large, not more than one, or perhaps two, should be cut at one time. It is always desirable, however, not to unnecessarily increase by the removal of living branches the wounds left on the trunk by the cutting off of dead branches or other excrescence. Whenever it is necessary to amputate a large or long branch, it should be cut first in such a manner as to leave a stump two or three feet long before the final operation of cutting it close to the trunk is undertaken. In this way the danger of tearing away by the weight of the falling branch portions of the bark of the trunk may be avoided. This will prevent, too, the serious accidents which often occur when a large branch is cut at first close to the trunk, when the end striking the ground may cause the butt to fly up and throw down the workman. It is an indispensable condition of the prompt healing over and perfect circulation of sap that all wounds should be evenly cut and shaped as nearly as possible to the trunk of the tree. In order to secure this condition, the operation of amputating a branch should be commenced by making a notch on its lower side. This notch should reach the middle of the branch; a second notch should then be made on the upper side of the branch, but further from the trunk of the tree than the cut. By adopting this method all danger, too, of injury to the trunk from the weight of the falling branch tearing away the bark will be avoided.

The operation of amputating a branch will not be complete, whatever method is employed, until the wound is made perfectly smooth. The workman may do this with his hatchet, used as a plane, the handle being held in one hand, and the point of the blade in the other.

Use of Coal Tar in Dressing Wounds.—All wounds made on the tree in pruning should be covered with a coat of coal tar applied with an ordinary painter's brush.

The importance of observing the directions which have been given, however trivial or unimportant they may seem, will be apparent when it is understood that the entire success of the operation of pruning, and of the future production of timber, depends on the proper application of these rules.

It should always be borne in mind that a cut perfectly smooth, and as closely following the line of the trunk as circumstances will permit, is soon re-covered with healthy straight-grained wood. In this connection it is well to quote from de Courval,

who speaks with the authority of experience, and who has shown with many varieties of trees the correctness of his statements. "A casual examination," he says, "will show that between the surface, which has been cut smooth and treated with coal tar, and the new tissues which soon cover it, there is only the thinnest crack or fissure analogous to the natural cracks or openings which always appear in wood in seasoning, and which, as is well known, do not diminish its strength, elasticity, or value for all industrial purposes.

In the preceding pages the general rules which should be followed in pruning forest trees have been given; the special methods applicable to each of the four classes in which trees have been placed according to their age will now be briefly explained.—*Journal of Forestry.*

THE Madras Forest Act received the assent of the Governor-General in Council on the 11th October.

But in order to remove doubts as to whether it were consistent with certain Acts of the Governor-General in Council, a further bill was necessary, which received the assent of the Governor-General on the 2nd November, and is as follows:—

ACT XXI OF 1882.

An Act to remove doubts regarding the Madras Forest Act 1882.

WHEREAS doubts have arisen whether the Madras Forest Act, 1882, is consistent with certain Acts of the Governor-General in Council, and it is expedient to remove those doubts: It is hereby enacted as follows:—

Enactments of the Governor-General in Council not to affect the Madras Forest Act.

1 No enactment of the Governor-General in Council shall affect, or shall be deemed to have at any time contained anything which would affect, the Madras Forest Act, 1882.

THE following rules, for removal of forest produce and hunting animals, have been passed by the Chief Commissioner of Assam, under the Garo Hills Regulations:—

The 9th October 1882

No. 80.—Under the powers vested in him by section 2 of the Garo Hills Regulation, 1882, the Chief Commissioner is pleased to prohibit all persons, not being natives of the Garo Hills district, from doing any of the following acts within the limits of the said district without a licence that is to say,—

Cutting wood.
Hunting animals.
Collecting wax, ivory, India-rubber, or other jungle products.

2. Licences for the cutting and removal of *gorkati*, or minor forest

produce, will be granted by the District Forest Officer in the form given below, on payment of a fee of 2 rupees for each licence:—

Form No. 21. (*In English and Bengal*)

FOREST DEPARTMENT, ASSAM.

District.

Book No. *Permit No.*

Name

Residence

FOREST.	Date of expiry of Grant.	Description of timber or other produce.	Number and quantity.	Rate.	Amount.	REMARKS.

The 188 . *District.*

3. These licenses will be procurable on application to mouzadars, lakmas, respectable shopkeepers, and others to whom books of them may be committed by the District Forest Officer for sale.

4. Every licence to cut and remove *gorkati* must be in the possession of the person cutting and removing the produce when he avails himself of it; and must be produced by him on demand for inspection by any forest officer, police officer, mouzadar, or other revenue official.

5. Licences for the cutting and removal of timber will be granted in the form specified in paragraph 2 above.

6. All trees covered by the licence must be paid for at the rates shown in the accompanying schedule:—

Schedule of rates of royalty.

Each tree of sal or sam ...	...	...	...Rs. 10
Ditto of other reserved kinds ...	...	...	... „ 6
Ditto of unreserved kinds ...	...	...	... „ 2

7. When not more than 20 trees are included in the licence, the full price payable must be paid at the time of an application for the licence. When more than 20 trees are included in the licence, half the price payable must be paid on application, and the remainder before the trees are removed from the sale depôts to which they are to be taken.

8. Licences to cut timber will be granted by the District Forest Officer, the forest-ranger in charge of the range, or the forester in charge of the forest. Sums exceeding Rs. 50 payable in respect of a licence must, however, be paid direct into the treasury at Tura before the licence is granted. Sums not exceeding Rs. 50 may be paid to the officer granting the licence.

9. Licences for hunting animals may be granted by the Deputy Commissioner on payment of a fee of Rs. 2 for each licence, and shall be in the following form:—

Licence for hunting animals.

FEE, Rs. 2.

To

Resident of

You are hereby authorised to hunt animals within the Garo Hills for one year from the date of this licence.

This license under Regulation I. of 1882.

II. You shall not kill pea-fowl from the 1st April to the 1st September.

III. You shall not kill any fawn or doe with fawn by her side.

IV. You shall not kill any elephant.

V. In case of breach of the conditions of this licence the animals killed by you may be confiscated, and you will be liable to the penalties prescribed in section 3, Regulation I. of 1882.

VI. The Deputy-Commissioner shall have power to cancel this licence should you cause any disturbance among the Garos, or for other political reasons.

The 18 *Deputy Commissioner.*

10. The conditions set forth in the licence must be observed by the licence.

11 Licences for collecting India-rubber shall be granted by the District Forest Officer on payment of a fee of Rs. 3 for each licence, and shall be in the following form :—

Licence for cutting India-rubber.

FEE, Rs. 3.

To

Resident of

I. You are hereby authorised to cut India-rubber within the Garo Hills district for one year from the date of this licence.

This license under Regulation I. of 1882.

II. You shall offer all the rubber cut by you to the Deputy Commissioner at Rs. 20 per maund, and you shall not sell it to any other person without special orders.

III. In case of breach of conditions of this licence, the rubber cut by you will be forfeited, and you will further be liable to the penalties prescribed in section 3, Regulation I of 1882.

IV. The Deputy Commissioner shall have power to cancel this licence should you cause any disturbance among the Garos, or for other political reasons.

The 18 *Deputy Commissioner.*

12. The conditions stated in the licence must be observed by the licencee.

13. Persons infringing any provisions of these rules will render themselves liable to penalties prescribed in sections 3 and 5, Regulation I. of 1882.

THE Government of India has refused to pass the Bombay Abkary Act referred to in our last number, as entailing amongst other provisions, forest departmental collection of the mohwa blossoms.

This is in consequence of the strong opposition of the non-official members of the Bombay Council, and of the Bombay public generally.

Mr. Baden-Powell's Manual of the Land Revenue systems, and Land Tenures of British India, has been published at the Office of the Superintendent of Government Printing. It has been very ably reviewed in the *Pioneer* as the first successful attempt to compare the land revenue systems of the different provinces of India. We hope to be able to say more about it in a future number.

One of the results of Lord Ripon's resolution to abolish the interference of jails with private industries, has been to throw the trade of Burmese wood-carving, which was a speciality in the jails of Rangoon and Moulmein, into private hands, and in order that this industry may not be lost, the Chief Commissioner has taken it in hand, and hopes to establish a Company of master carvers, who will carry it on.

SECRETARY'S LIBRARY

THE following extracts from the Lieutenant-Governor of Bengal's Resolution on the reports of the Board of Revenue for 1881-82, will be found interesting :—

Since his assumption of office, the Lieutenant Governor has received applications from capitalists for grants of waste land in the Trans-Teesta tract of the Darjeeling district, some of which he has been compelled to refuse. His reasons for refusing have, in each case, been communicated to the applicants; but Mr. Rivers Thompson thinks it desirable to explain here what are the motives which guide him in disposing of applications for waste land in this portion of the Darjeeling district. Under recent orders the area of the Daling sub-division, as the most recently acquired portion of the Darjeeling district is called, has been mapped out into three parts. One part has been reserved for tea cultivation; the second part has been allotted to native cultivation; Government forests and cinchona reserves comprise the third part. In the interests of the general Indian public, the cinchona reserves cannot be encroached upon. It is the policy of Government to supply to the people of this country a much-needed febrifuge at a *minimum* price, which shall not be higher than the bare cost of production. The area in the Darjeeling Hills, suited for the growth of cinchona, is limited; and it is believed that Government has occupied the whole of it. In the general interests of the community, therefore, whatever may be the future policy as to the maintenance of this industry by Government or its transfer to private enterprise, no concessions can be made which would reduce that area.

Regarding the forest area it may be truly said that the district with its valuable tea industry and growing population is already suffering seriously from the extent to which the hill-sides have been denuded of trees. The future interests of the district, the growing wants of the sanitarium, and the requirements of railway enterprise throughout Bengal, imperatively demand that the small forest area which remains should be carefully preserved.

SULPHUR FUMIGATION AS A PREVENTITIVE OF JUNGLE FEVERS. —OUR reader's attention is directed to a notice in "Nature" on the 20th September, page 544, about M. d'Abbadie's discovery that sulphur fumigation is a preventitive for marsh fevers. His paper was read in the Academie Francaise, and the reason for the good effects of sulphur fumigation is very obvious, the malarious germs being destroyed by sulphur dioxide. The principal difficulty lies in the application of the discovery, but only a small quantity of sulphur dioxide should be present in dwellings, enough to destroy the miasma without injuring the lungs of the occupants. For open air use, a small bottle containing *Sodium*

thiosulphate, commonly known to photographers as hyposulphide of soda, dissolved in 20 times its volume of water, and mixed with one volume of strong *sulphuric acid*, may be used like a bottle of smelling salts. This evolves sulphur dioxide, the escape of which should be regulated by a strong cork.

H. WARTH.

The following extract from the *Pioneer*, also refers to the same subjects :—

At a recent meeting of the Paris Academy M. d'Abbadie made some interesting remarks on the efficacy of sulphur as a preservative against marsh fevers. He stated that the elephant hunters from plateaux, with comparatively cool climates, brave the hottest and most deleterious Ethiopian regions with impunity, which they attribute to their habit of daily fumigation of the naked body with sulphur. Also some of the sulphur mines of Sicily are situated at a low level, where intermittent fever prevails; while the population of the neighbouring villages is attacked by fever in the proportion of 90 per cent. the workmen in the sulphur mines suffer very much less—not more than 8 or 9 per cent. being attacked. Again, on the west side of the marshy and fever-invested plain of Catania is a sulphur mine, with a colony of healthy workmen living about the mine, who seem to be preserved from the fever by the sulphurous emanations; whilst a little beyond, at a higher lever, is a village some time ago abandoned on account of marsh fever. The above facts would certainly encourage our Indian authorities to make experiments with sulphur in some of the fever-striken districts of India,—say, for example, in the deadly Terai.

V EXTRACTS FROM OFFICIAL GAZETTE.

1.—GAZETTE OF INDIA.—

No. 859*F.*—*The 3rd November* 1882.—*Messrs. F. d'A. Vincent* and *E. D. M. Hooper*, Assistant Conservators of Forests of the 1st Grade in the Punjab and the Central Provinces respectively, are transferred to Madras.

No. 890*F.*—*The 20th November* 1882.—Consequent on the reorganisation of the superior staff of the Forest Department under the Government of India, the following appointments, promotions, and transfers are made, with effect from the 3rd September 1882.

To be Conservators of Forests of the 1st Grade.

Lieutenant-Colonel W. J. Seaton, M.S.C.

Mr. W. Schlich, Ph. D.

Major J. C. Doveton, M.S C.

To be Conservators of Forests of the 2nd Grade.

Mr. G. Greig.

Captain E. S. Wood.

Mr B. Ribbentrop.

To be Conservators of Forests of the 3rd Grade.

Major F. Bailey, R. E.

Major C. J. van Someren, M. N. I.

Mr. A. T. Drysdale.

Mr. C. Mann.

Mr. Schlich will continue to officiate as Inspector-General of Forests to the Government of India during the absence on special duty of *Mr. Brandis*, or until further orders.

Mr. Greig and *Captain Wood* will officiate in the 1st Grade of Conservators of Forests until further orders.

Major Bailey and *Major van Someren* will officiate in the 2nd Grade of Conservators of Forests until further orders.

Mr. J. S. Gamble, M.A, Deputy Conservator of Forests in Bengal, and *Mr. H. C. Hill*, Deputy Conservator of Forests in British Burma, will continue to officiate as Conservators of Forests of the 3rd Grade until further orders.

To be Deputy Conservators of the 1st Grade.

Mr. H. Leeds, Punjab.

Colonel C. Batchelor 3rd B. E. L. C. Punjab.

W. Stenhouse, late 32*nd* M.N I., Punjab.

Lieutenant-Colonel *Mr. I. E.* O'*Callaghan*, North-Western Provinces and Oudh.

Mr. A. L. Home, Assistant Comptroller General (Forests).

Lieutenant-Colonel H. C. T. Jarrett, V.C., B.S.C, Central Provinces.

Mr. M. J. Slym, British Burma.

Mr. G. W. Strettell, Bengal.
Mr. R. H. E. Thompson, Central Provinces.

Mr. Home will continue to be Assistant Comptroller General (Forests) until further orders.

To be Deputy Conservators of the 3rd Grade.
Mr. C. Bagshawe, Hyderabad Assigned Districts.
Mr. I Macpherson (on leave).
Mr. F. B. Dickinson, Coorg.
Mr. D. E. Hutchins, Mysore.
To be Assistant Conservators of Forests of the 3rd Grade.
Mr. G. F. Taylor, Central Provinces.
Mr. A. Weston, British Burma.
To be Director of the Forest School, Dehra Dun.
Major F. Bailey, R. E.
To be Deputy Director of the Forest School.
Mr. W. R. Fisher, B.A.
To be Professor of Natural Sciences at the Forest School.
Mr. H. S. F. Warth, D. S. N.
To be Superintendent of Forest Surveys.
Major F. Bailey, R.E. (in addition to his other duties).
To be Deputy Superintendent of Forest Surveys.
Mr. W. H. Reynolds.
To be Superintendent of Working Plans.
Mr. E. E. Fernandez.

Mr. C. Bagshawe, Deputy Conservator of Forests, and *Mr. E. F. Litchfield*, Assistant Conservator of Forests, are transferred from the Residuary List to the North-Western Provinces and Oudh List *Mr. Bagshawe* will join in the North-Western Provinces on the completion of the special work on which he is now employed in Berar.

Mr. I. Macpherson, Deputy Conservator of Forests, at present on leave, is transferred from the Residuary List to the Central Provinces, Berar List.

Mr. D. E. Hutchins, Deputy Conservator of Forests, is transferred from the Residuary List to the Bengal-Assam List, but will continue to be employed in Mysore until further orders.

Mr. W. E D'Arcy, Assistant Conservator of Forest, is transferred from Berar to the Punjab. *Mr D'Arcy* will join in the Punjab on the return from leave of *Mr. A. Stewart*, Assistant Conservator of Forests in Berar

Mr. A. Smythies, B.A, Assistant Conservator of Forests, at present on leave, is transferred from the North-Western Provinces to the Punjab.

Mr. J. C Murray, Sub-Assistant Conservator of Forests, and Officiating Assistant Conservator of Forests of the 3rd Grade, is transferred from the North-Western Provinces to British Burma.

2.—Calcutta Gazette.—

The 16th October 1882.—*Mr. F. B. Manson*, Assistant Conservator of Forests, Kurseong Division, is allowed privilege leave for six weeks, with effect from the 17th instant.

The 28th October 1882.—*Mr. A. R. Grant*, Deputy Conservator of Forests, is transferred from the charge of the Palamow Forest Division to that of the Julpigoree Forest Division.

Mr. R. L. Heinig, Officiating Assistant Conservator of Forests, Julpigoree Division, is transferred to the Palamow Forest Division, and will hold charge of the Hazareebagh Forest Division in addition to his duties.

Mr. C. A. G. Lillingston, Assistant Conservator of Forests, at present attached to the Darjeeling Division, is transferred to the office of the Conservator of Forests, Bengal, to which he will be attached for employment in the Chota Nagpore forests or elsewhere.

The 13th November 1882.—*Mr. H. H. Davis*, Deputy Conservator of Forests, Orissa Forest Examination, reported his return to duty on the 6th instant, from which date he is appointed to the charge of the Orissa Forest Division.

The 21st November 1882.—*Baboo Sree Dhur Chuckerbutty*, Forest Ranger in the Buxa Division, is appointed to have temporary charge of the Julpigoree Forest Division, with effect from the date on which *Mr. R. L. Heinig*, Officiating Assistant Conservator of Forests, made over charge, and until relieved by *Mr. A. R. Grant*, Deputy Conservator, or until further orders.

3.—GAZETTE OF NORTH-WEST PROVINCES AND OUDH—

No. 702.—*The 21st October* 1882.—The untaken portion, *viz.*, 21 days, of the three months' examination leave granted to *Mr. J. C. Murray*, Officiating Assistant Conservator of Forests, attached to the Tons Division of the School Circle, by Notification No. 519, dated 26th July 1882, is hereby cancelled.

No. 749.—*The 11th November* 1882.—*Mr. J. M. Braidwood*, Officiating Deputy Conservator of Forests, Naini Tal Division, to be in charge of the Ranikhet Division, in addition to his other duties, until further orders.

No. 750.—*Mr. F. B. Bryant*, Assistant Conservator of Forests, Ranikhet Division, to be in charge of the Garhwal Division during the absence, on leave, of *Mr. O. Greig*.

No. 1717.—*The 23rd September* 1882.—Under clause (*c*) section 4, Act VII of 1878, the Collector of Pilibhit to be a Forest Settlement Officer for the purpose of enquiring into and determining the existence, nature, and extent of rights to forest produce alleged to be possessed by persons in Purgunnahs Pilibhit and Puranpur; and for the purpose of deciding what lands may be classed as reserved or protected forests under section 34 of the said Act.

4.—Punjab Gazette.—

No. 407.—*The 18th September* 1882.—*Mr. F. O. Lemarchand*, Assistant Conservator of Forests, Lahore Division, has obtained privilege leave of absence for two months and ten days, under section 73 of the Civil Leave Code, with effect from the forenoon of the 5th September 1882.

No. 408.—*Mr. C. S. Carr*, Assistant Conservator of Forests, 3rd Grade, is appointed to the charge of the Lahore Division, during the absence, on leave, of *Mr. Lemarchand*.

5.—Central Provinces Gazette.—

No. 3657.—*The 25th September* 1882.—Under section 19 of Act VII of 1878, the Chief Commissioner is pleased to declare that the area of mouzah Januna in the Warora tahsil of the Chanda district, which is bounded on all sides by the Government reserved forest of Moharli in that district, shall be deemed to be a reserved forest from the 1st November next.

No. 3703.—*The 29th September* 1882.—The Chief Commissioner is pleased to appoint *Mr. E. D. M. Hooper*, Assistant Conservator of Forests, 1st Grade, to officiate as a Deputy Conservator of the 2nd Grade, with effect from the 6th July last, *vice Mr. Whittall*, Deputy Conservator, proceeded on furlough.

No. 3827.—*The 7th October* 1882.—*Mr. W. P. Thomas*, Assistant Conservator of Forests, reported his arrival at Bombay on the 22nd ultimo, on return from the leave granted him by Notification No. 2611 of 16th July 1880.

Mr. W. P. Thomas is attached to the Direction Division which he joined on the forenoon of the 25th ultimo.

No. 3904.—*The 14th October* 1882.—*Mr. H. Moore*, Assistant Conservator of Forests, availed himself on the forenoon of the fifth current, of the leave granted him by Notification No. 3810 of that date.

6.—British Burma Gazette.—

No. 77.—*The 7th September* 1882.—Under the provisions of section 136 of the Civil Leave Code, privilege leave for three months is granted to *Mr. A. Weston*, Officiating Assistant Conservator of forests, with effect from the 16th September 1882.

No. 78.—*The 7th September* 1882.—*Mr. A. Weston*, Officiating Assistant Conservator of Forests, made over, and *Mr. T. A. Hauxwell*, Assistant Conservator of Forests, assumed, charge of the Shwaygyin Forest Division on the 12th June 1882.

Rules Relating to Examinations in Burmese.

Officers required to qualify in the Burmese language are divided for the purpose of these rules into four classes, as follows:—

Class I.—Officers of the Commission.

Class II.—Non-Burman Myo-Okes, Assistant Superintendents of Police, Assistant Conservators of Forests, Superintendents of Jails, and Civil Surgeons.

Class. III.—Non-Burman Inspectors of Police, Jailors in receipt of Rs. 100 per mensem and upwards, Medical Assistants in immediate charge of jails and dispensaries, and Sub-Assistant Conservators of Forests.

Class IV.—Non-Burman officers of the Educational Department.

An officer belonging to Class II will not receive any grade promotion until he has passed in the Burmese language by the lower standard.

An officer belonging to Class III will receive no grade promotion, and will obtain no increment of pay until he has passed in the Burman language by the Elementary Standard, and on failure to pass the examination within two years of appointment he will be liable to forfeit his appoint ment.

No. 80.—*The 12th October* 1882.—*Mr. H. C. Hill*, Officiat ing Conservator of Forests, Tenasserim circle, is appointed to special duty in the office of the Conservator of Forest, Pegu circle, with effect from the date on which he may make over charge of the Tenasserim Forest Circle to *Mr. Popert.*

No. 81.—*The 12th October* 1882.—*Mr. E. P. Popert*, Deputy Conservator of Forests, is appointed, on his arrival from furlough, to the temporary charge of the Tenasserim Forest Circle.

No. 82.—*The 12th October* 1882.—*Mr. A. Weston*, Officiating Assistant Conservator of Forests, availed himself of the privilege leave granted to him in this Department Notification No. 77, dated the 7th September 1882, on the 16th September.

No. 83.—*The 9th October* 1882—*Mr. F. W. Thellusson*, Assistant Conservator of Forests, 1st Grade, reported his return to duty from the leave granted to him in this Department Notification No. 56, dated the 26th June 1882, on the forenoon of the 23rd September 1882.

No. 84.—*Mr. F. W. Thellusson*, Assistant Conservator of Forests, 1st Grade, is placed on special duty in the Hanthawaddy District, with effect from 23rd September 1882.

7.—Assam Gazette—

No 258.—*The 30th September* 1882.—Privilege leave of absence for six weeks, under section 136, Chapter X of the Civil Leave Code, is granted to *Mr. T. J. Campbell*, Sub-Assistant Conservator of Forests, Assam, with effect from the 16th September 1882.

No. 259.—During the absence of *Mr. T. J. Campbell* on leave, *Mr. F. S. Barker*, Assistant Conservator of Forests, will remain in charge of the Darrang and Nowgong Forest Division

No. 268.—*The 6th October* 1882.—*Mr. T. J. Campbell*, Sub-Assistant Conservator of Forests, Assam, availed himself of the six weeks' privilege leave granted to him in Notification No. 258, dated the 28th September 1882, on the afternoon of the 16th September 1882.

8.—BOMBAY GAZETTE—

The 26th September 1882.—*Mr. W. G. Betham*, District Forest Officer, Khandesh, and *Mr. H. T. Ommanney, C.S.*, Forest Settlement Officer, Khandesh, respectively delivered over and received charge of the Khandesh District Forest Office on the 18th instant, after office hours.

The 29th September 1882.—*Messrs H. T. Ommanney, C.S.*, Assistant Collector and Forest Settlement Officer, Khandesh, and *G. M. Ryan*, Assistant Conservator of Forests, respectively delivered over and received charge of the Khandesh District Forest Office on the 22nd instant, before office hours.

The 7th October 1882.—*Messrs G. St. P. L Gibson*, Deputy Conservator of Forests, Belgaum, and *J. F. Fleet* Acting Collector of Belgaum, respectively delivered over and received charge of the Belgaum Forest Division on the 28th September 1882, after office hours.

The 10th October 1882.—*Mr. G. L. Gibson*, Deputy Conservator of Forests, Belgaum, who was in charge of the District Forest Office of Ratnagiri, Kolaba, from the 22nd May 1882, delivered over charge of that office to *Mr. R. Ryan*, Acting Assistant Conservator of Forests, at Belgaum, on the 21st September 1882, before office hours.

Mr. J. F. Fleet, First Assistant Collector of Belgaum, and *Mr. G. A. Hight*, Assistant Conservator of Forests, respectively delivered over and received charge of the Belgaum Forest Division on the 2nd October 1882, before office hours.

The 20th October 1882.—*Mr. G. A. Hight*, District Forest Officer, Belgaum, and *Mr. R. Ryan*, Acting Assistant Conservator of Forests, respectively delivered over and received charge of the Belgaum Forest Division on the 16th October 1882, before office hours.

9.—MADRAS GAZETTE—

The 14th October 1882.—*Mr. W. Carroll*, Sub-Assistant Conservator, in charge of South Canara Division, has been granted privilege leave of absence for two months, under section 136 of the Civil Leave Code, from the 8th instant.

T. Narayanasawmy Nayudu, Assistant Superintendent, Chinchona Plantations, Dodabetta, has been granted privilege leave of absence for fifteen days, under section 136 of the Civil Leave Code, from the date of availing himself of the same.

No. 201.—*The 26th October* 1882.—*Mr. E. H. Boileau* Deputy Conservator of Forests, Godavari Division, privilege leave for three months, under section 136, Chapter X, of the Civil Leave Code, 5th Edition.

The 27th October 1882.—Privilege leave of absence granted to *Maduranayagum Pillai* Forest Ranger in charge of Satyamangalam Range, in page 896, Part II, *Fort St. George Gazette*, dated the 8th August 1882, has been extended for fifteen days from the 24th ultimo.

[SUPPLEMENT.]

THE INDIAN FORESTER.

Vol. VIII.] DECEMBER 1882.

Notes for a Manual of Indian Sylviculture.

(*Continued.*)

General Remarks.

It will be apparent from the foregoing considerations that a mixed crop, which consists of trees of one and the same age, must, in most cases, become gradually either more or less pure, or differentiated into groups, each composed more or less exclusively of a single species. This species may be the one most suited to the given soil and locality; but it is not necessarily that one, and provided that both those main factors of production are sufficiently favorable for its prosperous growth, it is essentially that species which is the most tenacious and exclusive of the crop. Its tenacity will depend on the resistance it offers to the causes of injury described under Condition III, on its ability to live under shade, on its greater longevity, on the depth to which its roots penetrate, and on the greater facility with which it grows up again from the stool and throws up root-suckers; its exclusiveness will be due to the greater suitability of the soil, subsoil and locality for its growth, to the greater density and more favourable shape of its crown, to its capability of pushing up through the crowns of other species, to its greater rapidity of growth, to its superior stature, to the greater facility with which it shoots up again from the stool and throws up root-suckers, to the longer duration of its foliage and the season at which this is shed or renewed, and to the invasive spread of its roots or underground stems. The conclusion to be drawn is obvious. If our object is to raise mixed crops, we know that, as a general rule, we cannot secure a favorable and permanent mixture by having them of uniform ages throughout.

For further observations connected with this subject the student is referred to the general remarks under the Fourth Case.

Examples of the Third Case.

Instances of this Case are furnished by many mixed khair and sissoo forests, mixed tamarisk and babul forests, copses in which no standards are left, &c. Artificially raised forests coming under this head are very rare in India.

SECTION IV.—FOURTH CASE.—*Mixed crop composed of individuals of all ages.*

We have already seen that in a mixed crop consisting of trees of one and the same age, the consideration of the circumstances which decide the struggle for existence is extremely complicated, and that none of them can be examined apart without having to take into account the effects of some other or others. Under this head we have one more cause of complication, *viz.*, the existence of various ages. This circumstance influences more or less the working of nearly all the rest. The best plan is, therefore, it seems to me, to repeat all the headings of the Third Case, and consider under each what qualifying effect the difference of ages produces. Before proceeding to do so, I may say once for all that where no qualification is made, whatever has been said under that Case holds absolutely true also in the present one.

I. INNATE VIGOUR.—The comparative innate vigour of a plant will depend to a very great extent on its age. The natural sal seedling makes little head in the forest until its gradually increasing vigour enables it to make a sudden start when it is several years old; whereas its companions, the *Tetrantheras*, push up rapidly soon after they germinate. In the same way the two or three-year-old *Pinus excelsa* will grow up as vigorously as a deodar several years older. In many forests of the Central Provinces teak will remain only about a foot or two high until it is about twelve years old, when it will at once make a rapid start upwards. And so at a later age the vigour of one species will diminish earlier than that of another. In other and more general terms, the innate vigour of a tree will depend very much on its age, and greater age will not always be an advantage in the struggle for existence.

II. GREATER SUITABILITY OF SOIL AND SUBSOIL.—For one and the same species the unsuitability of a soil or subsoil increases with advancing age. Hence in the case of a soil that is well suited to only one of two species growing on it, the other may have a start of several years, and yet be ultimately overtaken and outstripped by the first. Here also read the remarks under Condition II of the Second Case.

III. DEATH, DISEASE, UNHEALTHY STATE, OR RETARDATION OF GROWTH BROUGHT ON BY CAUSES EXTRANEOUS TO THE FOREST, VIZ.:—

(*a.*) *Attacks of insects and other animals.*—The presence of old and decaying trees will cause a multiplication of insects, which may also injure to a less or greater extent the younger trees, and also individuals of other species. On the other hand, young seedlings of shade-bearing species will be protected against the ravages of deer, cattle, &c., if they spring up in the midst of a dense older growth of other species not touched by those animals.

As regards man, the presence of trees of different ages and different species is often a guarantee that the timber-dealer will, because they do not suit his purpose for one reason or another, spare many individuals of each species, which will then survive long enough to become the parents of a younger generation. The most casual visit paid to forests containing teak, sal and deodar, the most valuable of our Indian trees, will prove this.

(*b.*) *Attacks of parasitic and epiphytic plants.*—There is nothing new to add here after what has been said under the same head under the Third Case.

(*c.*) *Damage caused by climatic influences.*—Against frost, drought, and sunstroke the shelter of older trees of hardy species is often indispensable, and is always useful, to the permanence of other species that are delicate in their youth. In the torrid valleys and plains of Rajputana, nearly every nim tree springs up out of a Euphorbia bush; and, similarly in the Dehra Dun, nearly every tea bush has one or more toon plants growing up through it, so that a tea garden left to itself would soon degenerate into a pure toon grove. In the Changa Manga Plantation mulberry has possessed itself of the ground under the original sissoo. In creating a new forest where there has been none recently, it is often found necessary to raise at first a crop of a hardy species, under the shelter of which more valuable, but less hardy, species are afterwards introduced.

(*d.*) *Damage caused by fire.*—A crop consisting of trees of various species and different ages forms, as a rule, a denser growth and leaf-canopy than any other, and is hence exposed to less risk from fire.

(*e.*) *Floods.*—For the same reason a mixed forest of trees of different ages will generally offer more resistance to the violence of a flood.

(*f.*) *Injuries caused by felling, conversion, and export operations.*—As a rule it is the older trees that are felled. Hence there is seldom, if ever, any danger that the timber-dealer will make a clean sweep of an entire crop. The younger individuals left, consisting for the most part of seedlings, saplings or every small poles, will in most cases successfully resist all such injuries.

(*g*). *Climbers.*—There is no addition to make to what has been said under the Third Case.

IV. DENSITY OF THE LEAF-CANOPY; RELATIVE DENSITY AND SHAPE OF CROWN, AND RELATIVE CAPABILITY OF PERSISTING UNDER OR PUSHING UP THROUGH COVER.—All that can be said here has already been anticipated under the same Condition of the Third Case. I may, however, make a single additional remark. When a tree attains maturity, *i.e.*, reaches the point beyond which it begins to decline, the twigs and branchlets that develop every year

become fewer and weaker, especially in the upper part of the crown, where the branches gradually lose their vigour and, in some instances, die off. Meanwhile the lower branches continue to lengthen. The result is that the crown assumes year by year a rounded or flattened shape at the summit, and the foliage becomes everywhere increasingly spare.

V. RELATIVE LONGEVITY.—Younger individuals of some otherwise favorably circumstanced species may outlive trees of other kinds possessing greater longevity, thus enabling that species to maintain itself permanently in the crop in spite of inferiority in this respect.

IV. RELATIVE RAPIDITY OF GROWTH.—As said before, some species have their period of rapid growth early in life; others later. Hence young individuals of the former class may outstrip older trees of the latter class, and prevail in the end. But, on the other hand, these latter may be old enough to have entered upon their phase of rapid growth, and thus maintain the start they originally have in spite of disadvantages in other respects. As the relative ages of the trees of the several component species generally vary from point to point, the one result may follow as often as the other, thus guaranteeing the permanence, although in very different proportions, of all the species in question.

VII. RELATIVE MAXIMUM HEIGHT ATTAINABLE.—Age can obviously exercise no influence on this Condition.

VIII. RELATIVE SUITABILITY OF CLIMATE.—As under this Condition 1 have considered only the influence climate exercises on the general growth of one species taken in its entirety as compared with the similar influence it exercises on another, the question of age does not in any way affect the remarks already made under this head under the Third Case.

IX. SEEDING.—Under the Third Case this Condition was considered under six subheads, which were denoted by means of successive letters of the alphabet. Here we are obviously concerned only with subheads (*a*), (*b*) and (*c*), *viz.*, the relative abundance and frequency of seeding, and the relative vitality of the seed.

(*a*). *Relative abundance.*—A tree becomes fertile long before it has attained its full size and spread of crown, and remains so up to the moment of its natural death. With the majority of our species, the quantity of seed produced increases with the age of the tree until decline sets in, when it gradually diminishes as the crown contracts and becomes more and more spare from year to year. From this age onwards the fruitfulness of the tree generally diminishes rapidly. With individuals of different ages and species mixed indiscriminately in the crop, at every point will be found a tree of one species or another in more or less full bearing, so that every species will be represented by some individuals at least which can

perpetuate it in the crop, thus guaranteeing a permanent mixture of some at least, if not all, of those species.

(*b.*) *Relative frequency.*—In the case of those species which seed in a general manner only after an interval of two or more years, it is not uncommon to find some individuals here and there seed during that interval. Thus *Dendrocalamus strictus* flowers sporadically every year. Again, in Nimar, in the Central Provinces, *Hardwickia binata* flowered gregariously in 1873, not at all in 1874 and 1875, sporadically in 1876, and again gregariously in 1877. As a rule, the individuals that flower thus sporadically are among those which possess the least vital energy (this seems especially to be the case with *Dendrocalamus strictus*). Such individuals are generally the older ones. Hence it is an advantage for a species, which seeds only at long intervals, to be represented by at least a few old trees, which extraneous circumstances do not prevent from flowering and bearing fruit.

(*c*). *Relative vitality of the seed.*—As a rule old or very young trees produce seed, the vitality of which is more easily destroyed than that of seeds furnished by vigorous trees of middle age. Hence a species may be weak in numbers, and yet comparatively strong enough, from being represented chiefly by individuals of middle age, to be able to perpetuate itself.

X. Relative facility of growing up again from the stool.—All trees that are able to grow up again from the stool lose this faculty after a certain age, varying with the species, has been reached. During the first years this faculty is slight, then increases rapidly, remains stationary for a few years, and, lastly, gradually diminishes. Hence where clearings or fellings on an extensive scale are made, the next crop may consist of species which are not necessarily the most fitted for the struggle for existence; those most fitted for this struggle may be represented chiefly by old trees past their coppicing age, while the rest have also numerous young individuals in the original crop felled.

XI. Relative facility of throwing up root-suckers—The faculty of throwing up root-suckers is at first *nil*, then increases with the spread of the roots until the tree begins to decline, when the principal roots themselves gradually weaken and die off at their extremities.

XII. Relative duration of foliage, and season of its fall and renewal.—It is a general rule that within the same species very young individuals retain their foliage longest, and old ones for the shortest time; and that, if by any cause the foliage of the season is destroyed, the young (not always, however, the very youngest, since they are poor in dormant buds) individuals renew it earliest.

XIII. Gradient.—As the effect of gradient is rapid and effective drainage, it follows that on naturally dry slopes plants of a certain age and strength are more secure against fatal

injuries than very young ones with short and superficial roots.

XIV. RELATIVE DEPTH TO WHICH THE ROOTS PENETRATE.—The only effect that age has on this Condition is, that up to a certain period in the life of a tree the length of the roots is proportionate to its age.

XV. RELATIVE QUANTITY AND SPREAD OF THE ROOTS (INCLUDING THE RHIZOME).—The quantity and spread of the roots increases progressively with age until decline sets in.

XVI. A CLIMBING HABIT.—It is only after the first few years, when the young plant is thoroughly established, that a climber begins to nutate or throw up shoots which develop tendrils. Once this period is reached, age has no further effect as far as the climbing habit is concerned.

XVII. AN ARBOREAL HABIT.—This is a new Condition. An arboreal habit necessarily supposes the existence of different ages. Plants possessed of this habit are either (i) parasitic, like *Cuscuta*, fungi, &c.; or (ii) only partially parasitic, like *Viscum*, *Loranthus*, &c.; or (iii) purely epiphytic, like some figs, *Araliaceæ*, &c.

Parasites and epiphytes generally have already been taken account of under Condition III (*b*) as injurious "causes extraneous to the forest." In this place we have to deal with only such plants as form an integral portion of the forest, and have to struggle against others for a place in it. Under this category come only some of the species falling under class (iii).

In the case of trees with an arboreal habit, which, like the figs, become terrestrial as soon as their roots reach the ground, the epiphyte is bound to prevail over its temporary host, the stem of which is gradually strangled by, and in the majority of instances englobed within, the mass of roots thrown down by the latter.

The epiphytic *Araliaceæ*, nearly always also of climbing habit, do not, as far as I know, kill their hosts, but only weaken and deform them, in very much the same way as climbers do.

Readers of these Notes are requested kindly to supplement the preceding very incomplete remarks with the results of their own varied experience.

General Remarks.

From what precedes it will have been gathered that a mixture of different ages is favorable to the maintenance of a mixture of species. We have already seen that uniformity of age throughout a mixed crop tends to reduce the number of species, and, in most cases, to give an easy preponderance to a single one, the most tenacious and exclusive of the original mixture. So that the converse is also true, *viz.*, that difference of ages always promotes a mixture of species, and is often an

indispensable condition for growing a mixed crop: it gives a certain chance of existence to species which would otherwise be driven out by their more tenacious and exclusive companions. It requires only a cursory examination of a sal forest to convince oneself of the truth of this proposition. Where the trees are all of a more or less uniform height, and, therefore, presumably of about the same age, they are almost exclusively sal; whereas, where ages vary, many other species will be found associated with the sal, the relative proportion of those species generally increasing with the difference of ages. There can be no doubt that the pure character of the extensive teak copses of the Central Provinces, Berar, and Bombay are, in a great measure, due to a certain degree of uniformity of ages; it will generally be found that the purest of these copses are those in which the trees are pretty nearly of one and the same height.

Examples of the Fourth Case.

Instances of the Fourth Case are to be found everywhere in India. As some of the more important I may point to the majority of our teak and oak forests, to a great many sal and deodar forests, to our evergreen forests, &c.

SECTION V.—*Summary reasons why certain species are gregarious and others sporadic; and why some of these latter may, under special circumstances, become gregarious.*

From the considerations developed in the preceding sections, it will have been observed that a *gregarious* species is one which overcomes all others in the struggle for existence, and thus "has a tendency to form more or less extended masses of pure forest" (*vide* definition, p. 4). Such are sal, sissu, babul, the tamarisks, *Boswellia*, khair, *Mesua ferrea*, *Pinus longifolia*, &c. A study of the habits and requirements of these species will clearly explain why they are gregarious. By way of example for the student, I will select some of these species, and briefly give the characters which combine to render them gregarious. To enter into and discuss these characters in a full manner would carry me beyond the limits laid down for BOOK II of our MANUAL.

Sal.—This tree disappears the moment it reaches soil, the drainage of which is impeded. Its gregariousness is due to a great number of causes, some of which alone would be sufficient to give it an easy predominance over all other species in the soils which alone it affects. These causes are—

(*a.*). Perfect suitability of the soil which it generally occupies, so that, as a rule, it either flourishes in all its vigour or is completely absent.

(*b.*) Its nearly general immunity from the teeth of cattle.

(*c*). Its comparative freedom from parasites.

(*d*). Its comparatively easy recovery from injuries caused by timber operations.

(*e*). Its greater density of crown as compared with most of its associates of the same stature as itself.

(*f*). Its ability to form by itself a complete leaf-canopy.

(*g*). The ability of its young plants to persist under and push up through fairly dense cover, this latter faculty being considerably strengthened by their long, narrow crown.

(*h*). Its great longevity, exceeding that of nearly all its companions.

(*i*). Its relatively great rapidity of growth, after a certain age has been reached, right up to its attaining its full height.

(*j*). Its loftier stature as compared with nearly all its companions.

(*k*). Its comparatively great resistance to extreme temperatures, provided the rainfall and the relative humidity of the atmosphere are high enough, without the latter being sufficiently so to cause damp frosts.

(*l*). Its ability to grow almost equally well on all aspects within nearly* the whole vertical range of its distribution.

(*m*). Its profuse and all but annual seeding.

(*n*). The fall of its seed at the end of the season of forest fires, and at the beginning of the rains.

(*o*). The almost immediate germination of its seed.

(*p*). The great facility with which it grows up again from the stool.

(*q*). The persistence of its foliage during at least eleven months of the year.

(*r*). The great depth to which its roots can penetrate, enabling it to flourish even where the topsoil is waterless or the wind violent, and to escape strangulation during its early years by the deep vivacious network of roots of other species, like the grasses, &c.

(*s*). Its winged seed, enabling it, in spite of its great weight, to be wafted away a considerable distance from the parent tree.

(*t*). The production of more than one flush of leaves every year.

(*u*). The prompt appearance of a new flush of leaves, when the old foliage has been destroyed.

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* In the very damp climate of Bengal and Assam sal, as I am informed, naturally prefers the drier southern and western aspects. In the drier climate of the Central Himalayas and of Central India, it grows vigorously on all aspects, and it is only at very high elevations, above say 3,500 feet, that a really decided preference for the warmer southerly and westerly slopes is manifested.

(*v*). The very remarkable facility with which a new leading-shoot is formed on the death or disappearance of the original one.

(*w*). The number of strong vivacious buds at the root-collum of its seedling, often enabling this latter to survive the severest fires, frost, drought, &c.

(*x*). The thick, sap-gorged bark, which protects the cambium and dormant buds from external injurious influences.

(*y*). The great length of taproot developed by its seedling.

Sissu.—This tree, as a gregarious species, is confined to the shingly and loose silty deposits in the beds and on the low and frequently flooded banks of Himalayan streams, where they debouch into the plains, spreading out over a great width and often branching into a number of shallow arms, which embrace between them islands of various sizes. The loose open soil, from being for a time flooded, occasionally dries down to a depth of as much as twenty feet, if not more. The gregariousness of the tree is, of course, due chiefly to the nature of the soil and situation in which it delights; but a number of other causes also contribute in their respective degrees to the same end. All these various causes may be thus summarized:—

*(*a*). The exclusive character of the soil and locality which the sissu affects, khair, *Zizyphus* and a few other species being alone able to grow there in appreciable numbers.

(*b*). The general infrequency and but slightly injurious nature of forest fires in sissu forest.

(*c*). The great resistance of the tree to floods.

(*d*). Its extremely easy recovery from injuries caused by the wood-cutter and timber-exporter.

(*e*). Its ability to bear a good deal of shade and form a dense thicket while young.

(*f*). Its comparatively great longevity.

(*g*). Its great early rapidity of growth.

(*h*). Its ability to stand extreme temperatures, including the dampest frosts.

(*i*). Its profuse annual, rarely biennial, seeding.

(*j*.) The remarkably easy transportability of its seed by wind and water, long submergence being unable to destroy its vitality.

* It would be very useful to know exactly the respective conditions under which khair and sissu form pure and mixed forests. No doubt some of the readers of these notes could supply the necessary information, for which they would deserve the best thanks of all Indian Foresters. Mr. Lowrie has drawn my attention to the fact that in the Saharanpur forests sissu gradually disappears as the amount of soil increases, being replaced by khair. This is not entirely borne out by my observations elsewhere. Nevertheless it is unquestionable that sissu reproduces itself chiefly, if not exclusively, on loose sandy silt, before the soil begins to consolidate itself and cover itself with grass, while khair generally comes in after a certain degree of consolidation has taken place, and can, of course reproduce itself on firm grassy land.

(*k*). Its extremely ready germination.
(*l*). The great facility with which the tree grows up again from the stool.
(*m*). Its remarkable tendency to produce extremely abundant suckers, and the extraordinary vitality of its roots.
(*n*). The persistence of its foliage almost throughout the year.
(*o*). The great depth to which the roots penetrate.
(*p*). Extremely early seeding.
(*q*). Its nearly general immunity from parasites.
(*r*). The immunity its roots enjoy from the attacks both of white ants and rats.
(*s*). The prompt appearance of a new flush, when the old leaves have been destroyed by any cause.

Pinus longifolia.—The *Pinus longifolia* is a hill tree and flourishes in the poorest and driest soils, being able to attain its finest dimensions even on loosely-cemented shingly formations several hundred feet thick. Individuals of it are found as low down as 1,500 feet, and fairly large patches of it are to be met with in the moist outer Himalayan belt, but it forms really large gregarious forests only in the intermediate and dry inner belts at elevations ranging from 3,000 to 5,500 feet. The reasons for this gregariousness may, in a general manner, be briefly stated thus:—

(*a*). The extreme dryness and poverty of the soil and subsoil, which this pine delights in, and which most other trees avoid, and the immense continuous stretches of such soil to be met with at the altitudes which suit the tree. This is the chief determining cause of its gregariousness.
(*b*). Its almost complete immunity from damage from the mouth of cattle, and from lopping for fodder, that great cause of fodder-yielding trees in the Himalayas being kept down in the state of low bushes.
(*c*). Its greater longevity in comparison with the majority of its companions.
(*d*). The greater relative rapidity of its growth, and the superior vigour of its leading-shoot.
(*e*). Its taller stature in comparison with that of its ordinary companions.
(*f*). The greater relative resistance of the young pine to frost and drought.
(*g*). Profuse general seeding at short intervals, with fairly abundant seeding in intermediate years.
(*h*). The small size of the pine seed, which enables it to be caught in the smallest crevices or hollows in the hill sides, contrary to what happens with acorns which roll or are washed down in numbers to the

bottoms of the valleys and ravines—the oaks, be it remembered, are the only trees among its usual companions that are at all able to compete with the pine in stature, while *Pinus excelsa*, deodar, and the firs, which are equally large or larger trees, do not flourish except where the altitude becomes too great for *Pinus longifolia* to grow as an exclusive tree.

(*i*). The greater relative vitality of the pine seed, and the small proportion of it eaten by animals as compared with acorns, which are frequently worm-eaten and are devoured in large quantities by bears, monkeys, &c.

(*j*). Easy transport of the seed by wind and in consequence of the steep gradients affected by the pine.

(*k*). The extremely ready germination of the seed.

(*l*). The ability of the tree to grow on the steepest gradients.

(*m*). The ability of the pine to form a more or less complete leaf-canopy during at least half its youth.

(*n*). The unfavorable and even injurious nature of the humus which its decomposed needles yield, grass and many other herbaceous and even some woody plants being kept down or driven out from under the pine by it.

(*o*). Its extremely thick corky bark, which enables the pine to survive the severe annual fires.

Anogeissus pendula.—This tree is a denizen of the dry and arid tracts of Central India, where it forms dense, almost pure forests on the metamorphic formations of the Aravali range and on the Vindhyan sandstones of Bundelkhand. It gregariousness is due to the following combined causes:—

(*a*). Perfect suitablity of the soil and subsoil and the climate, which admit of only a very poor arborescent flora.

(*b*). Relatively slight injury suffered from forest fires owing to its low, dense, spreading interlacing crowns, which permit of no undergrowth; and comparatively easy recovery from injury thus sustained.

(*c*). Extraordinary power of recovery from injuries caused by the wood-cutter and cattle.

(*d*). Marked tendency to join and interlace crowns.

(*e*). Greater longevity than that enjoyed by the majority of its companions.

(*f*). Larger stature than that attained by most of its companions.

(*g*). Greater relative rapidity of growth of its seedlings after a certain age has been reached, and of its stool-shoots almost from their very first year.

(*h*). Markedly greater relative resistance to severe frost and fierce heat as compared with most of its companions except khair.
(*i*). Profuse annual seeding.
(*j*). Easy transport of its small and winged fruit.
(*k*). Singularly greater relative power of coppicing.
(*l*). Persistence of foliage during ten months of the year, while its companions are leafless for several months.
(*m*). Ability to grow on the steepest slopes.
(*n*). Relatively strong development of roots.

Boswellia thurifera.—This tree is spread over the whole region of Central India. It grows gregariously as an upper crop on the dry trap and sandstone hills there, but forms an entirely pure forest where the amount of iron in the soil is marked. In this last case, the single circumstance of the soil being ferruginous excludes every other species. The causes which render the tree gregarious elsewhere may be shortly stated thus :—

(*a*). Dryness, poverty, and rocky nature of the soil, which prevents most of the few companion species from rising above mere undergrowth.
(*b*). Its complete immunity against the depredations of destructive animals, including in most cases also man, since the wood of the tree is generally despised even as a fuel.
(*c*). Its singularly great resistance to the destructive effects of forest fires owing to its thick sap-gorged, vivacious, exfoliating bark, and its extremely easy recovery from damage sustained thereby.
(*d*). Its markedly greater relative rapidity of growth from the very first years.
(*e*). Its much higher stature in comparison with most of its companions, the few individuals of *Sterculia urens*, *Odina Wodier*, &c., that grow with it, being excepted.
(*f*). Its immunity against the fiercest heat of the sun, and its great power of recovery from the effects of frost.
(*g*). Its conspicuous ability to withstand the most prolonged drought.
(*h*). The annual abundance of its seed.
(*i*). The very ready germination of its seed.
(*j*). Its unique power of coppicing, and hence of withstanding any degree of mutilation.
(*k*). Its faculty of producing abundant suckers, especially from the roots of felled trees.

Hardwickia binata.—This is a tree of the dry tracts of Central and Southern India, and also grows along the foot of the Kaimur Hills from Rewah to Hazaribagh. It is confined

to strongly silicious soils whatever their origin, and attains its finest dimensions on rocky rugged ground, even where there is scarcely a vestige of soil. It sometimes forms pure forests, but oftener occurs as a top-story over an open undergrowth of *Anogeissus latifolia*, *Boswellia*, khair, teak, &c. The causes which combine to make it gregarious are—

(*a*). Relative unsuitability of the soil and subsoil, which it affects, for its few large companions.
(*b*). Its immunity against attacks of parasites.
(*c*). Its great relative powers of recovery from the effects of forest fires.
(*d*). Its remarkable powers of recovery from mutilation by man.
(*e*). The ability of its young plants to withstand the low dense cover of the ordinary companion species.
(*f*). Its unique power of working itself up through the overhanging crowns of those species.
(*g*). Its greater relative longevity.
(*h*). Its greater relative rapidity of growth when once it is established.
(*i*). The greater height attained by it in comparison with most of its companions.
(*j*). Its great resistance to the severest dry frost.
(*k*). Its ability to withstand the fiercest heat of the sun.
(*l*). Its extremely profuse general seeding once in every three or four years.
(*m*). The easy dissemination of its seed to several hundred feet from the parent tree, owing to the flat light pod.
(*n*). The great vitality of its seed up to the first fall of rain.
(*o*). The great facility with which the seed germinates.
(*p*). Its remarkable powers of coppicing until it is about 40 years old.
(*q*). The persistence of its foliage during at least 10½ months of the year.
(*r*). Its producing more than one flush of foliage during the year, each accompanied with a vigorous development of new shoots, and the first occurring while most of the companion species are leafless.
(*s*). The remarkable length of taproot developed by its seedlings.

In the preceding examples I have endeavoured to show, without entering into any explanatory details, why certain Indian species are gregarious. The reasons given are sufficiently obvious after a perusal of the discussion of the four cases, under which the struggle for existence among the plants of a forest crop was studied. I will now make a further application of the principles therein exposed, and show (I), why in

certain tracts in Central India teak is gregarious, and (II), why it is everywhere else only a numerically weak denizen of mixed forests.

(I). The places where teak is gregarious are either (i) alluvial flats along the courses of rivers, or (ii) small stretches of stiffish sandy soil once under squatter cultivation, or (iii) hillsides, flats or stretches of undulating ground, which have for centuries been subjected to the *dhaya* system of cultivation already described on page 111.

(i). The soil in the alluvial flats referred to is more or less saline, with a strong proportion of carbonate and sulphate of lime, and is in many instances submerged for a few days during the floods of the rivers. It is, on the other hand, extremely dry and hard for several feet below the surface when the rivers have subsided into their normal beds during the hot weather. These characteristics of the soil exclude most of the ordinary companions of the teak—*Terminalia tomentosa*, *Anogeissus latifolia*, khair, *Boswellia thurifera*, *Pterocarpus Marsupium*, *Sterculia urens*, &c. The few associates that follow it, like *Morinda citrifolia*, *Eriolæna Hookeriana*, *Acacia leucophlæa*, *Ulmus integrifolia*, &c., being beaten by it in the struggle for existence owing to the following causes:—

(*a*). Its wonderful power of recovery from damage caused by fire.

(*b*). Its relatively great power of resistance to floods.

(*c*). Its enormous spreading leaves, which choked up every other forest seedling in immediate contact with them.

(*d*.) Its remarkable faculty, while young, of piercing through thick cover overhead.

(*e*.) Its conspicuously greater longevity.

(*f*.) Its more rapid growth almost from the first years, and continued up to its attaining its full height.

(*g*.) Its greater stature as compared with most of its companions.

(*h*.) Its profuse annual seeding.

(*i*.) The extraordinary vitality of its seed, which the annual floods only helped to disseminate and prepare for immediate germination from the time these silt-formed tracts were deposited.

(*j*.) The remarkable facility with which up to an advanced age it grows up from the stool, and the enormous strength and height of the stool-shoots in their very first year.

(*k*.) Its ability up to a certain age (certainly 40 years) to form of itself a complete leaf-canopy, capable of killing out all undergrowth, even including grass.

(*l*.) The size and nature of its fallen leaves, which, when rain falls, get glued together into a thick continuous felt-like covering over the ground, which covering

decomposes slowly, smothers up almost every seedling produced underneath it, and is impenetrable to the rootlets of most seedlings that germinate above it.

(*m.*) The existence of a more or less perfect uniformity of ages due to the greater portion of the crop having sprung up within the short interval of years, during which the alluvial flats in question were deposited.

(ii.) The gregariousness of teak in the second instance may be accounted for thus :—

(*a.*) Profuse annual seeding of the trees round and inside the original fields, by which means the ground got sown to a certain extent everywhere with teak.

(*b.*) The cultivation of the soil furnished this seed with an excellent bed, whence the production of a certain number of vigorous teak seedlings every year.

(*c.*) The great vitality of the seedlings produced, which by throwing up shoots every year from the collum of the root, gradually strengthened themselves, and which the mere annual scratching of the rude plough damaged scarcely or not all.

(*d.*) These seedlings were obviously still further strengthened in a remarkable degree by the hand-plucking of all surrounding grass and weeds, the agricultural crop alone being never dense enough to impede their development and the wandering squatter cultivator never finding their presence sufficiently hurtful to eradicate them.

(*e.*) The extraordinary vitality of the seed, which, lying in the soil in large quantities when the field was abandoned, produced an abundant crop of seedlings during the ensuing two or three years.

(*f.*) The great rapidity and vigour of growth of the already established seedlings and young stool-shoots which, on the fields being abandoned, suppressed most individuals of such of the companion species as were able to reproduce themselves, like the teak, during the course of the squatter cultivation.

(*g.*) See (*k.*) of the preceding case.

(*h.*) See (*l.*) of the preceding case.

(*i.*) The more or less uniform height of the various individuals, due to their having finally started upwards all together on the abandonment of the fields in question, and giving to the crop more or less the character of one consisting of trees of one and the same age.

(iii.) The gregariousness of teak under the *dhaya*

system of cultivation may be explained by the following causes :—

(*a.*) Its great power of recovery from the worst mutilation, even in spite of annual fires.

(*b.*) The great power of its root collum of producing shoots up to a very great age (eighty years at the very least.)

(*c.*) The extraordinary vitality of its seed, even when scorched by jungle fires.

(*d.*) In the case of hillsides, their ruggedness offered numerous crevices and hollows for the lodgment and germination of the seed falling or rolling down from above.

(*e.*) The great relative vigour of its stool-shoots, which enabled them to overtop seedlings and similar shoots of other species.

(*f.*) The extremely dense crowns formed by its huge spreading leaves tolerating no undergrowth, and pushing back and choking up plants of the same height as themselves.

(*g.*) See (*k.*) of the preceding case.

(*h.*) See (*l.*) of the preceding case.

(*i.*) The great longevity of teak.

(*j.*) The ability of its young seedlings to withstand fairly dense cover, thus allowing an abundant advance growth to come up gradually, which shoots away upwards as soon as it is uncovered.

(*k.*) The contemporaneous springing up of the new stool crop as soon as the *dhaya* cultivator departed for fresh fields.

It now remains to explain why, the three preceding cases excepted, teak should everywhere be a denizen of mixed forests. The causes of this may be briefly summarized thus :—

(*a.*) In forests which contain teak, the soil is apt to vary from point to point with regard to the proportion of clay in it, with regard to the degree in which the surface or subsoil rock is fissured, and with regard to the freedom of the drainage. Where the soil is too binding or not sufficiently drained, or too dry for teak, or the rock is too compact, that species will simply refuse to grow, and any seedlings of it that may germinate in such places are bound soon to disappear.

(*b*). Where the teak grows, it is almost the only tree of which the timber is used, furnishing, as it does, everything from the large house beam and broad boards to the thin round rafter of the rude temporary thatched shed.

(*c*). Its young seedling, although it stands a fair degree of

cover *overhead*, is soon killed by the *immediate contiguity* of dense growth (like that of the grasses for instance), which exercises lateral pressure against it on every side.

(*d*). A great many of the companions of teak are more shade-bearing than itself, some being conspicuously so.

(*e*). Many of its companions grow more rapidly than itself from their earliest years as seedlings.

(*f*). The young plant is extremely sensitive to frost.

(*g*). In many places several of its companions exceed it in stature.

(*h*). Its seed, being large, does not find easy lodgment in the soil, and is exposed to be washed away during the rains.

(*i*) Again, as the seed is all shed by the middle of the hot weather, the greater portion of it used every year to be destroyed by the annual forest fires before special protective measures, of very recent date, were undertaken.

(*j*). The seed germinates with difficulty, requiring throughout nearly the whole of India to lie for at least one year in the ground exposed to the alternation of damp and drought.

(*k*). The seed is the common food of many rodents, parrots, &c.

(*l*). The upper portion of the root of the young seedlings is greedily devoured by rats.

(*m*). The majority of the associated species retain their foliage longer, and bring it out earlier than the teak.

(*n*). After a certain age teak loses the faculty of forming a complete leaf-canopy by itself, thus making room for the admission of other species even where it originally formed a pure crop.

(*o*). Some birds, as the bush quail (*Perdicula asiatica* and *Arghunda*) devour the cotyledonary leaves as soon as they appear.

(*p*). The teak limits the spread of its roots and rootlets to within five or six feet of the surface, and, taken relatively to that of many of its companions, the mass of these roots and rootlets is small and far from invasive.

The preceding examples* suffice to show that the gregariousness or sociability of our forest species is nothing but

* It would be very interesting, and for me personally a matter for deep gratitude, if readers of these Notes kindly added a few more examples after the manner which I have followed. For instance, those having long experience of deodar might explain under what conditions it grows gregariously and when in mixture with a large proportion of other species. Foresters in Assam could tell us why *Mesua ferrea* generally forms pure forests. Those who know Mysore could tell us all about the Sandalwood. From Sindh we could have an explanation of the causes of the gregarious character of babul and the tamarisks.

the result of a struggle for very existence between two or more of them, and the consequent survival of the fittest. The fittest are, however, not always our most valuable trees, whether absolutely so or because they favour the growth of those which are; and we as foresters must, therefore, often intervene in the struggle and aid the weaker to conquer the stronger. Hence the most practical end intended to be served by the considerations developed in the preceding sections of the present Chapter is that they might furnish us with the key wherewith to study and analyse accurately the behaviour of each one of our more valuable species in that struggle, to note under what circumstances it can hold its own against all its rivals, under what circumstances it has to yield to its stronger neighbours, to what extent and how these latter circumstances may be favorably modified by the forester, up to what point the struggle is useful in drawing up the trees, in naturally forming their boles or in any other way improving their growth or the quality of their timber. Armed with such facts, we can, with the full confidence that knowledge begets, interpose with the most appropriate effective measures, as soon as the necessity arises, to shorten or prolong the struggle as the case may require, and to continually aim at securing the most advantageous proportion and distribution of the various species and age-classes—in other words, attain the very end and object of Sylviculture, which are the largest and most useful production in forests grown for the market, and the most effective tree-covering, combined, whenever possible, with a large and useful production, in forests grown for protection.

SECTION VI.—*Ought we to grow pure or mixed forests?*

As has just been said in the concluding observations in the immediately preceding section, the object of the sylviculturist, according as he is growing his forests for the market, or chiefly for purposes of protection, is to obtain either (*A*) the maximum and most useful production of which the soil is capable; or (*B*) the most effective living vegetable covering, combined, whenever possible, with a large and useful production.

§ 1.—*A. Forests grown exclusively for the market.*

To obtain the maximum production alone the following conditions must co-exist:—

(i). *The forest must be composed of the most suitable species for the soil and climate.*—Both these elements generally vary from place to place and often even from point to point, and the species must, therefore, vary accordingly, since there is no single one that will grow equally well under ever changing conditions of soil and climate. Hence advantage in a *mixture of species.*

(ii). *The forest should consist of the greatest number of stems possible at any given stage of growth.*—This is secured by con-

stantly maintaining as complete a leaf-canopy as possible—a result best attained by a *mixture of species* possessing different habits, different requirements as to soil, situation, and aspect, and a different ramification and spread of roots; besides, making different rates of growth, and reaching different statures.

(iii). *The trees should attain the greatest length of bole possible under the given conditions of soil and climate.*—This end also is best secured by a *mixture of species*, thanks to which the trees attain various heights, their crowns press one against another, and the depth of the leaf-canopy is always maintained at its maximum, the result being forcing in height and rapid elongation of the boles up to the maximum limit possible for each species.

(iv). *Continual improvement of the soil until its maximum fertility is reached, and constant maintenance of that maximum thereafter.*—To secure this end we must have—

(*a*). *An abundant annual production of foliage yielding a rich humus.*—Some trees produce more foliage than others, *e.g.*, sal and *Terminalia tomentosa* than teak; in the hills the oaks, deodar, and the firs than *Pinus longifolia*; and so on. Then, again, the leaves of some trees decompose more easily and form a richer humus than those of others: thus, for instance, *Terminalia tomentosa* and sal are better in this respect than teak; the oaks, than *Pinus longifolia* or any other conifer.

(*b*). *The, as much as possible, constant maintenance of a complete leaf-canopy, in order to protect the soil, including its covering of dead leaves*—

(α). *From the sun's rays*, which would dry up the soil rapidly and hinder the formation of humus;

(β) *From winds* which would blow away the covering of dead leaves, besides accelerating the evaporation of moisture from the soil;

(γ). *From the direct action of rain*, which would wash away the covering of dead leaves and humus, besides carrying away in abundance soluble substances fit for plant food;

(δ). *From (to a great extent) fire*, by keeping the layer of vegetable debris moist, and impeding the production of a strong draught of wind (in case a fire occurred) which would only fan up the flames;

(*c*.) *The prevention of fire*, which would, besides destroying all the organic matter in the topsoil, bake its surface hard.

All the objects mentioned under this fourth main head are most completely attained by means of a *mixture of several species*. If the species composing a forest are all, or most of

them, deciduous, some of them are sure, or at least very likely, to be in leaf, while the others are bare, and thus a green canopy (imperfect it may be, but nevertheless a green canopy) will be secured during as many months of the year as possible; whereas, when there is only a single species, and that a deciduous one, the whole forest may be leafless for a considerable time, and the soil completely exposed to injurious influences. Moreover, when several species grow together, they form not only a denser but a deeper mass of continuous foliage, the obvious consequence being a more abundant production of leaves, area for area, than if the forest were pure.

(v). *The forest must be protected against storms, fires, insects, hide-binding, snow-break, and many other causes of destruction or malformation of the trees.*—The closer the growth is, the less risk is there to fear from storms, fires, snowbreak, &c. *A mixture of species* produces the closest possible growth for any age, soil, and climate. Then, again, the denser the forest is, consistent with the healthy development of the trees, the less danger is there to apprehend from insects, and the less likely are the trees to become hide-bound. Here again a *mixture of species* is desirable. Besides this a mixture of species has still another advantage; as insects are sometimes selective, some of the trees are sure to be spared when the rest are attacked.

In order to secure, besides *the maximum production*, also *the most useful produce* of which the soil and climate combined are capable, the following additional conditions must exist simultaneously with all the preceding:—

(vi). *The forest must be composed only of marketable species, the largest proportion possible, if the forest is mixed, being assigned to the most valuable (principal) species, consistent with the realisation of all the other conditions.*—The necessity of this condition is obvious.

(vii). *The forest should, if possible, consist of a mixture of species.*—Mixed forests yield more varied and, therefore, more widely useful produce. Different industries require different descriptions of wood and other forest products, and our aim ought to be to satisfy all present and future requirements with the least amount of inconvenience and expense to the people. A judicious mixture of species is the surest means to this end.

§2.—*B. Forests grown for protection.*

Conditions (i), (ii), (iv), and (v), discussed in the preceding subsection, hold good here as *necessary* conditions; while (iii), (vi), and (viii) are *useful*, but not necessary. The forest should be composed of the most suitable species for the given soil and climate; it should contain the greatest number of stems possible at any given stage of growth; the soil should be continually improved and protected; and, lastly, the trees should afford

each other mutual security against all extraneous accidents. If in addition to this, the trees acquire the greatest length of bole attainable, are all marketable, and belong to various species, the forest, besides fulfilling in the most complete manner its special and original rôle of affording protection, will also furnish a large quantity of useful produce.

§3.—*Forests may sometimes be grown pure.*

From the considerations developed in sections 4 and 5 of the present Chapter, it is obvious that the raising of pure forests is to be generally avoided. Under certain special circumstances, however, forests *may* or *must necessarily* be grown pure.

It may be laid down as a general rule that a species *may* be cultivated by itself only when the following three conditions are realised at one and the same time :—

(i). *It should be able to form of itself a complete leaf canopy up to an advanced age, certainly not much below that at which it becomes fully fertile;* for under no other circumstance would (*a*) the fertility of the soil be increased or maintained, (*b*) the natural pruning of the boles of the trees be effected to the desired extent, and (*c*) the forest yield anything approaching the maximum amount of produce of which it is capable.

(ii). *The effective factors of soil and climate should be uniformly favorable for its prosperous vegetation over a more or less considerable area.* Unless this area were absolutely large, the pure crop thus composed could scarcely be considered more than a mere patch of trees forming a small part of a much larger whole of truly mixed forest.

(iii). *The produce furnished by the given species should either be in such great demand that every square inch of the soil ought to be devoted to its cultivation, or possess such a high market value that the cultivation of any other species in mixture with it would result in an appreciable loss of possible revenue.*

These conditions would not unfrequently be realised in certain stretches of sal forest, in toon plantations on extremely favorable ground, &c.

Exceptionally a species, which does not satisfy the first of the three preceding conditions, *may* be raised pure—

(i). *When it is exploited on a very short rotation.*—During their youth all trees protect the ground well enough, since the young stems not only bear standing close together, but also possess low crowns almost reaching down to the ground. Teak coppice furnishes a good instance of this: under a full crop, say of from 800 to 1,000 stems per acre, not a single blade of grass can make its appearance. A bamboo brake is another excellent case in point.

(ii). *When the soil is such that its fertility is not impaired by a defective covering of trees.*—We may instance marshy land, to which the admittance of sunshine and wind is, in truth, benefi-

cial, and the bottoms of many valleys as well as many low-lying places, which always remain moist or wet in consequence of their situation, and where the soil is always deep, rich, and free, thanks to the humus and vegetable debris continually washed down on to it from the higher surrounding ground. Even on such soils, it is desirable that the single species chosen to be raised should be as shade-bearing as possible, so as to compose a more or less complete leaf-canopy.

It has just been explained under what circumstances a species may be grown pure. In the following case there is no alternative but to raise pure forests :—

When the soil is such that no other species, whether marketable or not, will grow on it; for example, the stretches along the Indus which tamarisk or babul alone can occupy ; along streams at the foot of the Himalayas, where sissu or khair only will succeed ; some of the laterite tracts in Burmah, where eng is the sole tree ; and so on.

One point in favour of pure forests is that their working is simpler than that of mixed forests, since there we have to study and satisfy the requirements of only a single species.

But it is especially and exclusively in the raising and treatment of those forests that this greater simplicity is marked, as will be clear after comparing together the considerations developed in the first four sections of the present Chapter. In revenge, when there is only a single species in the crop, the lines on which work must be carried out are necessarily very inelastic, and everything must be done with a more or less mechanical regularity, little scope being left for altering the system of management from time to time in order to suit the ever-changing conditions of the country and the market.

§4.—*Advantages of a mixture of species.*

In the subsections which precede, it has been shown that pure forests should be the exception, mixed forests the rule. In Sections 1 and 2 it was explained how every condition for obtaining the largest amount of the most useful production or the most effective tree-covering, combined, whenever practicable, with a large and useful production, was realised by means of a mixture of species. This is now the place specially to examine the advantages to be derived from growing mixed forests. They are briefly as follow :—

I. Mixed crops, as a rule, form a denser leaf-canopy than pure ones.—In a mixed forest some trees attain a large stature than others, have a differently shaped crown, are more or less shade-bearing, thrive better on certain soils and in certain situations, and so on. The leaf-canopy is hence composed of crowns of various shapes and sizes, and situated at various heights above the ground, and fitting into one another like the gravel and stones in concrete, thus generally forming a closer-

packed mass of foliage than if the forest were composed entirely of any single one of the same species as constitute the mixed growth. Now in every forest, whether pure or mixed, the number of stems standing must necessarily diminish progressively with advancing age by the death and disappearance of some of the trees. In a pure forest, unless the component species be extremely shade-bearing, the intervals thus produced between the crowns of the surviving trees are bound to become rapidly wider and wider, until at a comparatively early age the trees, all more or less of the same height, stand well apart from one another and cease to protect the soil except in a very incomplete manner. In a mixed forest, on the other hand, during a considerable part of its life, the gap produced by the disappearance of any of the trees will nearly always be filled up by the upward growth of those immediately below or by the extension of the adjacent crowns chiefly of individuals of other species. Hence the greater density of a mixed forest becomes more conspicuous with increasing age, and mixed crops, as a rule, maintain a complete leaf-canopy up to a more advanced age than pure ones of the same species—a very great advantage for the forester in many cases.

II. A judicious mixing of species increases the amount of lignevus production.—For the same reasons that the leaf-canopy becomes denser, the number of stems standing per unit of area at any age becomes larger. Besides this, the greater density of the leaf-canopy produces longer boles, and improves the soil, and hence prolongs the period of sound growth. All these circumstances result in a larger production of wood, and especially timber.

III. It is only by a mixture of species that with annual successive working we can cultivate our more valuable species in the greatest abundance, over the widest extent of country possible, and of the finest quality and size.—Many of our most valuable species, like teak, *Dalbergia latifolia*, *Lagerstræmia Flos-Reginæ*, &c., and in many localities even deodar and sal, grow naturally in company with other trees. If we sought rigidly to obtain pure crops, we must either clear away all these latter, and leave a few isolated individuals or patches of the former to form the sum total of the standing growth; or, if we insisted on having a full growth on the ground, we must cut away every individual of those valuable species where they could not grow gregariously, and restrict them to those places, of limited extent, and few and far between, where they could—the one result being as much to be avoided as the other. On the other hand, by studiously preserving and favouring the growth of every individual of our valuable species, whether it stands by itself or in company with others of its own kind, provided it does not interfere with the growth of another more valuable than itself, we

produce the classes of timber and wood most in demand in the largest quantity possible, and also spread their production over the widest extent of country possible, and thus raise them as near as possible to the consumer.

Then, again, as a mixture of species, by producing a denser leaf-canopy, improves the soil, forms long and well-shaped boles, and delays the commencement of natural decay, our valuable species are enabled thereby to acquire their finest qualities, and attain their largest dimensions. So that any of them, grown in company with a soil-improving species (*i.e.*, one which puts forth abundant foliage, that decomposes easily and yields a rich humus), will furnish timber of good size and quality even on soils on which it could not thrive by itself. Thus we know that sal, deodar, and especially teak, acquire much finer dimensions in mixed forests than when growing pure, and this most conspicuously on soils that are in themselves more or less unfavorable for their growth.

IV. A judicious mixing of species furnishes produce suited for a greater variety of purposes, and hence giving occupation to an absolutely as well as relatively large portion of the artisan class of the country.—This is especially so in advanced communities. We in India are still in a very backward condition. But the signs of the times are already encouraging, and in many parts of the country various woods, which only a few years ago no one would literally look at, are now coming into the market; while for some of them there is an established and rapidly increasing demand. In many parts of Berar and Central India the *Boswellia thurifera* is readily bought up at high rates in the shape of boards for flooring and packing cases, and as building wood, although about half a generation ago there, and at the present day elsewhere, the wood of that species was or is despised even as an occasional fuel. The timber of *Terminalia tomentosa*, which used generally to be a drug on the market, is now universally valued for railway sleepers. The formerly, and in many places still, despised *Pinus longifolia* is now exported in large quantities from the hills into the Punjab plains and passed off as deodar. In some parts of the Central Provinces, *Ougeinia dalbergioides* poles command higher prices than teak of similar size. In the vicinity of spinning factories *Zizyphus Jujuba*, which formerly served chiefly for fuel and fencing, is now in great demand for cotton mill spindles. Such examples may be indefinitely multiplied. We have in India unlimited resources for cabinet-making, the manufacture of matches, and other wood-using industries. Enterprise and time will soon show us how to employ them.

V. A mixture of species tends to increase the production of minor produce, such as seeds, fodder, &c.—As a rule, it is the young tender leaves of trees that are used as fodder for cattle. Now

in a mixed forest the various trees bring out their new foliage at different periods of the year, so that a more continuous supply of fodder is thereby assured. Moreover, in such a forest, some of the species, being of a low habit, or not being valued for their wood except as fuel, can often be lopped without any appreciable damage to the standing growth, and must even frequently be so lopped for the improvement of this last. Nay individuals of the more valuable species themselves must very often be cut out or lopped in order to favour the development of the rest.

This advantage, which I have numbered (*V*), is so obvious that it needs no further discussion.

VI. Many kinds of trees are less liable to damage in mixed than in pure forest from storms, fire, frosts, snowbreak, hide-binding, insects, game, cattle, and diseases in general.—In company with a deep-rooted species, another with superficial roots is able to resist storms almost as well as the former. Even superficially-rooted species protect one another when mixed, by reason of the denser leaf-canopy they form than when they grow pure. For the same reason the chances and destructiveness of fire are diminished in a mixed forest. This is especially the case in crops of mixed conifers and broad-leaved species as compared with those of conifers alone. In forests containing conifers the admixture of broad-leaved trees protects the former from snowbreaks to a very great extent, thanks to the support afforded to their branches by neighbouring individuals of those species. Then, again, as insects generally attack sickly trees (which are relatively not numerous in mixed forests), and often, if not generally, confine their depredations, when they attack healthy individuals as well, to a single or only a few species, their ravages are naturally not so extensive in mixed as in pure forests. And if the forests in question contain conifers, the companionship of broad-leaved trees is beneficial, as the numbers of the natural enemies of insects (birds, rodents, &c.) are generally increased by their presence. Again species, which in early youth are delicate, find much more protection against frost, drought, &c., in a mixed than in a pure forest. Another beneficial effect of mixture is, that it contributes very materially towards the diminution of diseases of which the attacks of fungi are either the symptom or direct cause. Lastly, trees, the leaves of which are eaten by cattle or deer, run less risk of being browsed down when they grow here and there mixed with other species than when they all stand together as they do in pure forests.

VII. The relative suitability of the soil and locality for our various species is most easily recognised when they are growing together; and it is only then that the forester can at once know for certain what species to grow or favour in any given soil or locality.—This advantage comes out most conspicuously in a

new country like India, where so little is yet known of the habits and requirements of even our principal species, and this especially so when sowings or plantations on a large scale are to be made. Mistakes committed in executing the various forest operations can be detected much more easily in mixed than in pure crops, and generally, if not always, early enough to prevent any serious or further damage.

VIII. Mixing species in a forest economises labour and time, and facilitates work and supervision.—Given a certain definite area of forest and certain species to be grown there. If these species are raised pure, they will of course occupy as many distinct sections of the area; and, if an annual supply of the wood of each species is required, a portion of each section will have to be worked every year, thus creating so many independent centres of work. But if all these species were intermixed, the same result would be obtained by working at only a single point every year, and the whole area would be divided into a regular succession of coupes of convenient extent, instead of innumerable small patches very difficult to look after and work, because those taken in hand in any given year are necessarily scattered here and there all over the forest without any definite order.

IX. A mixture of species contributes in various ways towards equalising the length of the rotation required by our various species.—A species that protects the soil very imperfectly after a certain comparatively early age has been reached, must allow it to deteriorate, unless it is cut soon after. The soil, deteriorating on account of the imperfect leaf-canopy, reacts on the species, and weakens and arrests its growth, and this induces premature decay. A soil improving species, on the other hand, will never fail to attain the finest growth of which it is capable on any given soil, which it will gradually render more and more suitable for itself. Now mix both species together, and thanks to the improvement of the soil effected by the second, and to the denser leaf-canopy and the maintenance of favorable influences due to the mixed growth, the longevity of the first must necessarily be enhanced.

X. By a mixture of species a forest is generally able to yield marketable produce at an earlier age than if it consisted of pure crops.—The reason is obvious. The trees, thriving better, often acquire, in spite of the closer growth, a given size at a younger stage of growth. But, what is more to the point, as the stems in a mixed forest are more numerous, the first series of exploitations (*cleanings* and first *thinnings*) become necessary much earlier. Besides this, as in a mixed forest, owing to the different habits of the trees and their different requirements as to light, not only does a given number of stems form a denser leaf-canopy than in a pure forest, but a gap made in that

canopy is sooner filled up, so that, with no heavier stock on the ground, the first cuttings may be made earlier.

XI. When a forest is regenerated naturally, its regeneration is better assured if it is mixed.—Seeds of one species or another are sure to be produced in less or greater abundance every year all over the forest. A great number of these must germinate, and, wherever sufficient light reaches the ground and other conditions are favorable, a large proportion of the seedlings thus produced must establish themselves. Moreover, as the seeds of different species germinate with different degrees of facility and require different degrees of heat and soaking, it is certain that, whatever the character of the season of vegetation, some seedlings cannot fail to be produced every year. Thus in mixed forests regeneration is continually going on with more or less vigour; and when the natural conditions for the development of an abundant seed-crop and the germination and establishment of the young seedlings are favoured by the forester by means of certain special operations, the chances of failure are singularly lessened.

XII. Mixed forests, as a rule, yield a larger revenue than pure forests, provided of course that the component species are all marketable.—This follows directly from II, III, IV, V, VI, VIII, and X.

XIII. A mixed forest adorns the country more than pure forest, and thus affects beneficially the physical, æsthetic, moral, and mental development of the people.—This advantage is not to be despised, and is by no means of slight importance in its effects on the genius of a people. The finest poetry has had its inspiration from the forests. The manliest portion of a nation is generally that which inhabits the interior or the borders of forests. The beneficial influence of forests is seen in the universally admitted necessity of people's parks, &c., in civilised communities.

§5.—*Conditions necessary for a mixture of species.*

In a general manner it may be said that the possibility of obtaining and maintaining a mixed growth depends—

1. *On the suitability of the soil for the more or less prosperous growth of more than one species.*—Many large stretches of laterite in Burmah practically exclude the existence of other species besides the eng. In the Central Provinces certain ferruginous soils can bear nothing but *Boswellia thurifera*. *Terminalia tomentosa* occupies almost by itself patches of stiff, wet soils in the immediate vicinity of sal and teak forest. And so on. It is not enough if two or more species can simply grow in a given soil; their vegetation on it should be vigorous enough to enable them to survive in the struggle for existence with little or no extraneous aid on the part of the forester.

2. *On the suitability of the climate and locality for the more or less prosperous growth of more than one species.*—This is self-evident.

3. *On the ability of the mixed species jointly to maintain and improve the fertility of the soil.*—If the mixed growth were such that the soil deteriorated under it, then the proportion of some one species, the hardiest and most vivacious of the mixture, would, in the majority of cases, gradually increase to the detriment of the rest, and in time the crop would consist wholly, or almost wholly, of that species.

4. *On the requirements of the several species as regards light.*—All woody species require light in order even to simply remain alive, but some can bear shade better than others. Generally speaking the ability of a plant to bear shade is proportionate to the shape (spread and depth) of its crown, as well as to the height of the latter above the ground. We may also say that transplants in plantations stand heavier shade than seedlings raised *in situ* in sowings, since the former, owing to the arrested development of their main roots due to the operation itself of transplanting, absolutely require a certain degree of shade to prevent a too rapid transpiration. Moreover, seedlings, whether transplants or raised *in situ*, suffer less under shade than stool-shoots or root-suckers, since growing, as they do, much less vigorously than the two latter they demand less insolation.

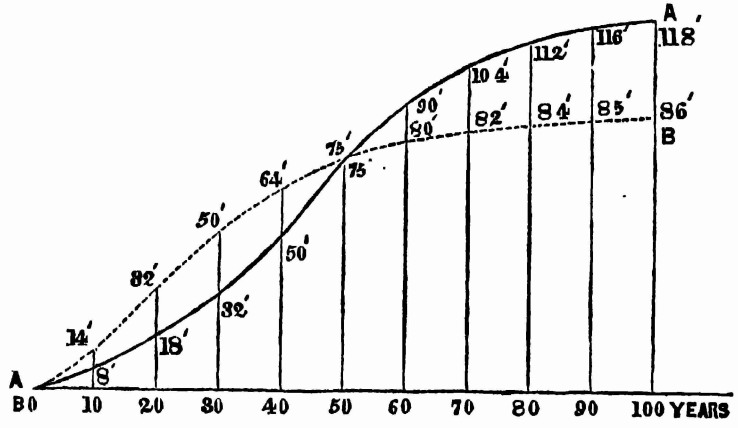
5. *On the relative hardihood of the several species.*—The hardihood of the various species during their youth is very various, and depends in a great measure on the character of the locality and soil in any given case. In certain localities, and in certain soils, some species cannot do without the protection against frost and drought afforded by shade and cover, while others, again, although able to grow up in the open, nevertheless thrive better when sheltered. And, generally speaking, all species whatsoever suffer less from shade in good soils and in a mild equable climate than anywhere else.

6. *On the relative rapidity of their growth in height at various ages, especially during their youth.*—It matters a great deal whether in a mixed crop the more shade-bearing species grow up with greater, equal, or less rapidity than the rest; and the importance of this consideration is naturally greater during their youth than at any other time. To take only a single instance, if the crop consists of individuals of more or less the same age or height, it is obvious that the more rapidly growing species, provided they are also the most shade-bearing, will, as soon as they meet their crowns over the rest, kill or at least permanently throw back these latter; while, if the crop is quite young, these must be entirely killed out wherever the former are numerous enough.

Regarding the rate of growth in height of our various

species in mixed forest, we have no trustworthy information. And, indeed, in a continent like India, we are bound to obtain very different figures for one and the same species according to the locality and the region in which it may grow in each case. When such information is forthcoming, it will be very useful to make comparative diagrams of the relative rapidity of growth of different species standing together in the same forest.

The varying rapidity of growth of each species would be delineated by a curve with its generating rectangular co-ordinates, the abscissa representing the age, and the ordinate the height of the average tree at that age. For the sake of example, I give below a comparative diagram for two trees, which I will call respectively A and B; the curves are traced by means of the respective heights attained at 10, 20, 30, 40—100 years of age.



The above diagram shows at a glance that up to the age of 74 years B grows faster than A; at 75 it is overtaken by the latter, which then gets away from it. The rapidity of growth of A is slow for the first ten years, then becomes rapid up to seventy years, after which it decreases gradually, and becomes almost stationary. B, on the other hand, grows up rapidly at once, until it reaches the age of seventy-five years, and then makes little head afterwards. In the diagram $\frac{1}{10}$ inch on the axis of X, or horizontal line, represents one year, and similarly $\frac{1}{10}$ inch on the axis of Y, or, which comes to the same thing, on the perendicular lines, represents one foot.

7. *On the quantity and spread of the roots of the several species.*—This circumstance always possesses a certain degree of importance. Some species develop a larger mass of roots and rootlets than others. One species will throw out its main roots horizontally, while those of another will, for the most part, run through

the ground obliquely, and sometimes (as in the well-known cases of sal and jand) even vertically, being thus able to draw nourishment from the deeper layers of the soil. The roots and rootlets of some species are invasive, while those of others, especially while in the seedling stage, wither away in too close contact with the same organs of another species, with which they may be growing.

8. *In the majority of instances, on the presence of different-aged individuals.*—This point has been explained in sufficient detail under the head of "General Remarks" in Sections III and IV of the present Chapter.

§6.—*General rules for growing mixed crops.*

We may now lay down the following general rules to be observed in growing mixed crops :—

I. The predominant species, whether there be several or only one, ought to be soil-improvers. This rule requires no explanation.

II. Shade-bearing species may be intermixed, if they possess the same rate of growth in height, or if the slower growers can be protected against the more rapid growers either—

(*a.*) By artificial cultivation a certain number of years in advance of the latter.

(*b.*) By being able to produce naturally an advance growth under the old standing crop, while the more rapid growers can be reproduced naturally only by means of actual regeneration fellings, thus gaining a sufficient start on these latter.

(*c.*) By cultivation, whether artificial or natural, in sufficiently predominant numbers.

(*d.*) By pruning and lopping off overhanging branches of taller growth of other species, or keeping it down by topping or cutting it back wherever and whenever necessary.

III. Shade-bearing (in other words, dense-crowned) species may be intermixed with shade-avoiding (in other words spare-crowned) species, when these latter grow more rapidly or are given a sufficient start ahead of the other. This start must, of course, be sufficient to prevent their being ever outstripped and thus overtopped.

IV. Shade-avoiding species ought not to be intermixed by themselves in any permanent manner, since in crops so composed the soil is not only bound to degenerate (violation of Rule I), but the slower growers must inevitably be suppressed by the rest.

Exceptions to this Rule:

(*a.*) *On a fertile soil, which a spare or interrupted leaf-canopy cannot hurt, a mixed growth may consist of shade-avoiding species only.*

(β.) *On very poor soils, such as those on which the Boswellia thurifera, &c., thrive, other shade-avoiding species, provided they are sufficiently valuable, such as teak, &c., may be mixed with the former. This mixture is often not only justifiable but also necessary. For instance, in many forests consisting chiefly of Boswellia, the teak has no other nurse to protect it against frosts.*

V. Individuals of species, which do not form the prevailing tree in a forest, ought to stand scattered singly, or in small bouquets, and not in large groups, in the midst of the remaining growth. If those species have dense crowns, such groups would hurt with their heavy shade trees of other species standing round them, without helping them to any appreciable extent in clearing their boles; while if they possess spare crowns, the soil below them would necessarily deteriorate. Besides this, unless the species forming the surrounding growth possessed the same requirements as to light as the trees composing the groups, the stems standing along the edge of those groups would grow unequally, putting on more wood on one side than on another, and would thus be ill-adapted for boards and scantlings of the better descriptions, which would obviously contract and expand in the most irregular manner, and thus be subject to warp very considerably.

Moreover, as has been already shown above (§4, advantage XI) a mixture of several species facilitates the natural regeneration of a forest, so that the existence of pure groups here and there throughout the forest increases the difficulty of its natural regeneration.

Exceptions to this Rule :—

(α) *When the fertility of the soil varies so that we have well-defined patches of distinctly different degrees of fertility, there is no alternative but to allow each patch to be stocked with the species, be it one or several, best suited to it.*

(β) *When a shade-avoiding species has to be cultivated side by side with a more rapidly growing and particularly dense-crowned species, there is similarly no alternative.*

(γ) *Certain individuals of a crop are sometimes preserved, when the rest of the crop is felled, in order to allow them to acquire larger dimensions. These must inevitably inflict some injury, by the cover of their crowns, on the succeeding new generation. But the mischief can evidently be minimised by selecting them standing in groups of greater or less extent.*

§7.—*Characteristics of an auxiliary species.*

The meaning of the expression "auxiliary species" has been clearly explained in Chapter I on DEFINITIONS. But after what has been considered in the foregoing sections, we are

now in a position to lay down more strictly the full connotation of that term.

An auxiliary species must fulfil the following essential conditions :—

1. *It must become readily marketable as soon as it has reached the pole stage.*—Until this stage of growth has been attained, every individual tree and shrub in a crop, by its struggle for existence with its neighbours, contributes towards the favorable development of that crop. After this period a tree here, and a tree there, hampers the free growth of, or threatens to suppress, others more valuable than itself, and must, therefore, be removed at once. Unless the stems thus cut are collectively readily marketable, and their sale-value is at least sufficient to cover cost of felling and removal, it is evident that the unproductive nature of this operation would, in the majority of instances, prohibit its ever being undertaken at the right moment.

2. *It must be a soil-improver.*—This condition is obvious, if the other species in the crop are shade-avoiding, and, therefore, spare-crowned ; and it is equally obvious that, if these latter species are shade-bearing and hence dense-crowned, their auxiliary must also be dense-crowned, and thus necessarily a soil-improver.

3. *As a consequence of the immediately preceding condition, it must also be shade-bearing.*—To be dense-crowned is to be shade-bearing.

4. *It must be able to thrive in the same soil as the principal species.*—This is a truism.

5. *It must possess a different ramification of branches and roots from that of the principal species.*—In other words, it ought to be able at once to occupy or fill up space in the soil and in the leaf-canopy, which the principal species cannot profitably utilise ; and it must be able to do this without tending to invade and strangle the crowns and root-apparatus of the latter.

6. *Its stature must not be less than the minimum length of bole demanded from the principal species.*—In no other way, save very exceptionally, could this length of bole be produced, and the leaf-canopy, at the same time, maintained in a complete state.

7. *If natural regeneration is sought, the auxiliary species should be able to reproduce itself spontaneously and readily by seed from a few seed-bearers only ; and if the regeneration is to be effected artificially, its propagation by means of sowing or planting, or both, ought to be easy and inexpensive.*—It stands to reason that as a crop ages, the relative proportion of the principal species ought to increase as much as practicable. Hence we must be able to effect the natural regeneration of the auxiliary species with as few seed-bearers as possible.

8. *Its longevity ought to be at least equal to the term required for the trees of the principal species to attain their full length of bole.*—Otherwise, after the death of the trees of the auxiliary species, none could be produced for years to take their place, and in the meantime the absence of companions to help in drawing them up and in pruning their boles naturally would affect detrimentally the longitudinal growth of the trees of the principal species.

The preceding is a complete enumeration of the *essential* characteristics of an auxiliary species; it remains now briefly to mention the *useful* and *desirable*, but not essential, characters of the same. They are—

1. *Rate of upward growth, until the high pole stage is reached, somewhat slower than that of the principal species.*—In other words, it is desirable that at no stage of growth should the auxiliary be able to rise up on a level with, much less to overtop, the principal species.

2. *A hardy constitution.*—Young individuals of the auxiliary species should be able to stand a certain appreciable degree of exposure.

3. *Longevity not inferior to the rotation applicable to the principal species.*—This is the best guarantee for successful natural reproduction of the auxiliary species, for the presence of a sufficient number of seed-bearing individuals of it, when the crop comes under regeneration just before being felled, is thereby assured.

4. *Ability to shoot up again readily after repeated cutting back or topping off.*—Many an individual of the principal species must be saved from suppression by faster growing individuals of the auxiliary class, and this can be done only by keeping these latter down for a time by cutting them back or topping them, as the case may require, once or more frequently.

5. *Persistence of foliage during as many months of the year as possible, combined, of course, with a lower stature* (*Essential Condition* 6), *and slower rate of upward growth* (*Useful and Desirable Character* 1).—This will add to the effectiveness of the auxiliary species as a soil-improver, and as a nurse for any advance growth that may come up.

6. *Accommodating nature as regards soil and situation.*—The possession of this quality must materially facilitate the culture of the auxiliary species in the general interests of the entire crop.

Section VII.—*Causes of deterioration of a forest.*

I may most appropriately close the present Chapter on the *Struggle for Existence* by summarily detailing the causes which lead to the deterioration of a forest. These causes may be collected under four main heads: (*A*) the degeneration of the

soil; (*B*) unfavorable modification of climatic conditions; (*C*) faulty operations; and (*D*) defective protection.

A.—Degeneration of the soil from—

(*a*). All the component species being shade-avoiding, and hence contracting and thinning their crowns at too early an age.

(*b*). Incompleteness of the leaf-canopy, even when soil-improving species are on the ground.

(*c*). Excessive removal of layer of dead leaves as they fall.

(*d*). Fires.

(*e*). Flooding, with either (i) infiltration and deposit of injurious saline substances, or (ii) the soil rendered marshy for a less or more protracted period owing to deficient drainage.

(*f*). Excessive hardening and caking of the surface by the tread of cattle.

(*g*). Formation of landslips, including the washing away and erosion of the surface soil by rain.

(*h*). Formation of a too acid humus.

B.—Unfavorable modification of climatic conditions due to, or manifested by,—

(*a*). The clearing of adjoining forests.

(*b*). Severer, or more frequent, untimely frosts.

(*c*). Diminished and irregular rainfall.

(*d*). More frequent and violent storms.

(*e*). Heavier and more frequent falls of snow and protraction of the time during which it lies on the ground.

(*f*). Sensibly hotter and drier winds.

(*g*). More frequent recurrence of destructive hail storms.

(*h*). Sensible change in the average temperature of the seasons.

C.—Faulty operations, *viz.*—

(*a*). Opening out leaf-canopy too much.

(*b*). Taking out more than the actual sum of production.

(*c*). Untimely or neglected fellings.

(*d*). Felling in one place over too extended an area.

(*e*). A faulty mixture both as regards the species selected for cultivation, and their respective proportions.

(*f*). Unsuccessful regeneration.

(*g*). Faulty arrangement and succession of coupes and fellings.

(*h*). Indiscreet export operations.

(*i*). Injudicious manner of making fellings and cuttings.

D.—Defective protection against—

(*a*). Fire.

(*b*). Cattle.

(*c*). Ravages of game and insects.
(*d*). Promiscuous cutting and lopping for fodder, manure, &c., including the exercise of injurious rights.
(*e*). Destructive floods, and erosion and landslips.
(*f*). Offenders.
(*g*). Multiplication of destructive fungi and other parasites, and undesirable epiphytes.
(*h*). Destructive climbers.

CHAPTER III.—*Classification of Indian Forests.*

In the preceding Chapter the conditions which regulate the natural struggle for existence between the individual plants of a forest crop were studied with special reference to India. As those conditions necessarily vary from region to region, from locality to locality, our forests also vary in a corresponding degree with regard to the component species and their relative proportions. All these different classes of forest may, however, be reduced to a few broad well-defined types founded on permanent and clearly-marked characters. The following scheme is an imperfect attempt to exhibit this classification as far as the very incomplete materials at my command permits me to do.

I.—EVERGREEN FORESTS—
- (1) Littoral forests.
- (2) Swamp forests.
- (3) Babul forests.
- (4) Tamarisk forests.
- (5) Tropical evergreen forests.
- (6) *Pinus Merkusii* forest.
- (7) Temperate forests—
  - (i) *Castanopsis* and *Engelhardtia* forests of Sikkim.
  - (ii) Oak and magnolia forests of Sikkim.
  - (iii) Oak and magnolia forests of Burmah and Assam.
  - (iv) *Pinus Khasya* forests of Burmah and Assam.
  - (v) *Pinus longifolia* forests of the Western Himalayas.
  - (vi) Temperate oak and rhododendron forests of the Western Himalayas.
  - (vii) Himalayan box forests.
  - (viii) Cypress forests of the Western Himalayas.
  - (ix) Forests of deodar and its allies.
  - (x) *Pinus excelsa* forests of the Western Himalayas.
  - (xi) The Nilgiri forests.
- (8) Alpine evergreen forests—
  - (i) Rhododendron forests of the Eastern Himalayas.

(ii) Alpine conifer forests of the Eastern Himalayas.
(iii) Silver fir forests of the Western Himalayas.
(iv) Juniper forests.
(9) Sandalwood forests.

II.—Deciduous Forests—

(1) Forests of cold weather leaf-shedders—
(i) Sissoo forests.
(ii) *Boswellia thurifera* forests of Central India, including Berar and the Deccan to within 20 miles of the Western Ghats.
(iii) Alpine birch forests.
(2) Forests of hot weather leaf-shedders—
(i) *Quercus semecarpifolia* forests of the Western Himalayas.
(ii) Sal forest.
(iii) Mixed forests in which teak is present.
(iv) Mixed forests without teak.
(v) Eng forest—
(a) *True Eng forest.*
(b) *Hill Eng forest.*
(vi) Khair forest.
(vii) *Hardwickia binata* forest.
(viii) Bamboo forest.
(ix) *Anogeissus pendula* forests of Rajputana and Bundelkhand.
(x) *Melanorrhœa usitata* forest.

The first great division into evergreen and deciduous forests is founded on the persistence of the foliage, according as the majority of the component species are evergreen or deciduous. The subdivisions of the first class are based on differences of climate, soil and locality; of the second class on the season of leaf-fall. The seventh subclass of evergreen forests will be examined under seven types, the first and second subclasses of deciduous forests under three and seven types respectively. These types are by no means exhaustive of their corresponding subclasses, but they seem to me to represent the more important forms of these latter according to my present imperfect knowledge and experience, and I may be allowed to retain them provisionally until more extended acquaintance with our forests, and information kindly supplied by others, enable me to draw up a more complete analysis, in which subtypes would with advantage be admitted.*

* I would earnestly invite readers of these Notes in other parts of India, especially the Madras and Bombay Presidencies, Mysore, Coorg, Lower Bengal, Assam and Burmah, to correct, through the medium of the "Indian Forester," the numerous errors of omission and commission, which it was impossible not to make in attempting, with my necessarily limited experience and materials, to reduce to distinct types the countless forms of forest growth in India. Had I not felt confidence

In the following Sections I have endeavoured to be as brief and summary as possible; lengthy and detailed descriptions will find their place in Book III.

SECTION I.—EVERGREEN FORESTS.

1. LITTORAL FORESTS.—These are low-lying forests growing on silty alluvial land bordering the sea, and ascending the larger rivers as far as the tidal wave. They are found along the coast and tidal creeks and lagoons of the Peninsula, of Bengal and of Burmah, and skirting the estuaries of the Indus. Salt water is a necessary condition of existence for these forests, and types and subtypes are produced according to the degree of saltness of the water, which degree varies with the quantity of fresh water brought down by rivers or falling as rain. Along the sea itself, and often far extending into it, are found the true mangrove forests consisting of species of *Rhizophora, Bruguiera and Ceriops*, &c. The ground is muddy in the extreme and more or less destitute of low vegetation. But as we ascend the streams and estuaries, where the ground is covered only during spring-tides, the undergrowth becomes denser and consists of coarse sedges and seedlings of the larger trees. while the true mangroves gradually give place to species of *Avicennia, Sonneratia*, and *Heritiera*, which form the prevailing trees, and *Phœnix paludosa* occurs. In the Gangetic delta the higher land bears in many cases almost pure forests of the well-known *Heritiera littoralis (Sundri*, whence probably the name SUNDARBANS for all the forests of that delta).

In this subclass may be included forests of *Casuarina equisetifolia* and of other trees growing on the salt sea sands, and also of cocoanut growing on saline calcareous sand along the seashore.

A remarkable fact to note in connection with Littoral Forests is the occurrence there of certain species, like *Pongamia glabra, Cordia Myxa, Tamarix indica*, &c., which are also found indigenous inland many hundred miles from the sea and out of brackish soil.

Do fires by any chance ever occur in any of these forests? And if so, under what circumstances and with what severity?

2. SWAMP FORESTS.—This class of forest occurs on land subject during the rains to freshwater inundations, sometimes to a depth of 6 feet, and where the surface of the ground remains more or less muddy throughout the year. Bamboos are generally absent; herbage, with the exception of sedges, is

in receiving the help I solicit, I should not, I need hardly say, have prematurely published these Notes. which are more in the way of first suggestions how to treat the subject of the present Chapter, than a formal, although imperfect, description of the various classes of Indian forests. I venture to cherish the hope that *corrections and additions* will pour in and flood me with an *embarras de richesses*.

scanty; and orchids and ferns cover the trunks and branches of the trees. The characteristic species in such forests in Burmah are chiefly *Anogeissus acuminata* (*deciduous*), *Mangifera*, *Elæocarpus*, *Garcinia succifolia*, *Barringtonia acutangula*, &c. In Eastern Bengal and Assam they are *Dillenia indica* and *Lagerstræmia Flos-Reginæ*, the latter being, however, a deciduous tree. In Oudh and the North-West Provinces the principal species are *Barringtonia acutangula*, *Albizzia Lebbek*, *A. procera*, *A. stipulata*, *Trewia nudiflora*, *Randia uliginosa*, &c., all, however, deciduous trees. I may also mention Eugenias, Willows, Canebrakes and the *Putranjiva Roxburghii* as generally characteristic of Swamp Forests.

3. Babul Forest.—The babul (*Acacia arabica*) forms large masses of pure forest in Lower and Middle Sindh, where it covers upwards of 27,000 acres, and in the Northern Deccan and in Guzerat, and, to a small extent, in the Umballa district of the Panjab. This tree produces every year an abundant crop of seed, which germinates freely, especially where, as in Sindh during the floods of the Indus, it finds enough moisture to get thoroughly soaked. In the Northern Deccan and in Guzerat, where the tree grows chiefly on strong loamy soils, the germination and spread of the seed is facilitated by its passing through goats, who greedily devour it and thus favour the Babul at the expense of any other species which may come up at the same time, but which cannot survive their fatal bite. Mr. Drysdale says that in the Berars the *babul bans* are dense enough to prevent any undergrowth, grass included, from coming up, and that fires do not consequently occur.

What is the nature of the undergrowth, including grass, and of what frequency and severity are conflagrations in these forests in other parts of India?

4. Tamarisk Forest.—Extensive forests of this subclass occur on the low, moist, alluvial lands, which are often impregnated with salt, along the Indus and its tributaries. The frequent new formations of such land along the banks of the shifting rivers get covered early in spring, on the subsidence of the floods, with a dense mass of tamarisk seedlings, mixed more or less with young plants of *Populus euphratica* and *Acacia arabica*, under trees of which species the tamarisk forms a close undergrowth.

Is there any herbage in these forests, and do fires ever occur?

5. Tropical Evergreen Forests.—This subclass of Evergreen Forest is confined to the Moist Zone, where the rainfall is 70 inches and upwards. Large areas of it occur in the plains and hills of Burmah and Assam, in Sikkim and South-Eastern Bengal, and in the Western Ghats. It is known as Lower Hill Forest in Bengal and Assam. It occurs in shady valleys, on the slopes of hills up to 3,000 feet, along watercourses,

and wherever an abundant perennial supply of moisture in the soil is available. The growth is exceedingly dense, and the variety of species is very great, comprising trees of all dimensions, which sometimes form a mass of foliage 200 feet thick. The lofty trees which tower above the rest are frequently deciduous. Among them may be noted *Artocarpus Chaplasha*, *A. Lakoocha*, *Albizzia Lebbek*, *A. stipulata*, *Schima Wallichii*, *Pterocarpus indicus*, species of *Dipterocarpus* and *Sterculia*, *Xylia dolabriformis*, &c. To these may be added numerous species of *Ficus*, including the Caoutchouc tree, which develops a larger crown and attains a greater girth and height than any other tree in the moist forests of Assam. There are also oaks, *Castanopsis*, laurels, species of *Meliaceæ*, (the most noteworthy of which is the toon), *Mesua ferrea*, which predominates over large areas in Assam, &c. Bamboos of various species often form a conspicuous heavy undergrowth; gigantic creepers intertwine amongst the trees; palms, screw pines, *Scitamineæ* and ferns are abundant; but grassy herbage is rare. As regards shrubby vegetation, it is densest along open watercourses, in cleared spots, and along the outskirts of the forest, and often disappears entirely in dark places in the interior. In Bengal, in spite of the dense growth and evergreen nature of this subclass of forests, fires are annual, unless specially kept out, and do much damage. In Assam, on the other hand, it is believed that fires are unknown. (Is this true?) In Oudh and the North-West Provinces there is, perhaps, a fire in only one year out of ten, and this always late in the hot season, since the total combustible matter consists of the dry leaves, which accumulate on the ground only after the grass outside the forest has already been burnt up to its very edge, and which can, therefore, take fire only by the act of an incendiary. In Burmah fires rarely occur. As there is combustible matter in these forests during only a very short period of the year, and the quantity of it is inconsiderable, and as the leaf-canopy is constant throughout the year, it follows that conflagrations, when they do occur, do comparatively slight damage, and can be easily controlled.

More information, especially as regards Southern India (including the Bombay Presidency) is required and will be very thankfully received. It will, perhaps, be necessary to establish types in order to do justice to the vast and varied areas which these forests cover. For instance, it seems to me desirable to treat of "Mesua ferrea Forest" as one type.

6. PINUS MERKUSII FOREST.—This pine forms forests on the sandstone hills of Upper Tenasserim at altitudes varying between 1,500 and 2,500 feet, and also occurs as solitary trees down to as low a level as 500 feet above the sea.

What is the nature of the undergrowth, grass included, and what is the nature, prevalence, and severity of forest fires?

7. TEMPERATE FORESTS.—These are all hill forests and extend vertically from an altitude of about 3,000 feet up to about 8,000 feet, ascending, however, in some cases, as in the deodar type, much higher. The prevailing species are either evergreen broad-leaved trees with a few deciduous ones, of which *Quercus semecarpifolia*, *Engelhardtias*, maples, walnut, *Andromeda*, and *Alnus nepalensis* are among the chief, or conifers either pure or mixed with broad-leaved trees. Where broad-leaved trees prevail, various kinds of oak, *Castanopsis*, magnolias and laurels, *Bucklandia populnea*, *Rhododendron arboreum*, &c., are the principal trees, associated with *Andromeda ovalifolia*, *Arundinaria*, maples, species of *Cornaceæ*, *Celastrineæ*, &c. The box occurs locally over limited areas, and the yew (*Taxus baccata*) is sometimes met with. The trees are frequently covered with epiphytic ferns and mosses, and *Loranthaceæ* are common. The types of this subclass are very numerous, but for the present, until more information is collected, the following eleven may be noted:—(i) *Castanopsis* and *Engelhardtia* forests of Sikkim; (ii) Oak and Magnolia forests of Sikkim; (iii) Oak and Magnolia forests of Burmah and Assam; (iv) *Pinus Khasya* forests of Burmah and Assam; (v) Forests of *Pinus longifolia* of the Western Himalayas; (vi) Temperate Oak and Rhododendron forests of the Western Himalayas; (vii) Box forests; (viii) Cypress forests of the Western Himalayas; (ix) Forests of deodar and its allies; (x) *Pinus excelsa* forests of the Western Himalayas; (xi) The Nilgiri forests.

(i). *Castanopsis and Engelhardtia Forests of Sikkim.*—This type is met with between 3,000 and 6,000 feet of altitude. The chief and most numerous trees are species of *Castanopsis*, *Engelhardtia spicata*, *Prunus Puddum*, *Alnus nepalensis*, *Juglans regia*, *Bucklandia populnea*, maples, birch, &c., with a few oaks at the higher elevations. Toon grows scattered throughout these forests, and attains a huge size, some trees yielding logs measuring 500 cubic feet. The undergrowth is especially dense in the more open portions, and consists of *Artemisia*, *Rubus flavus*, *Mœsa indica*, *Sarauja*, *Eurya*, &c. Tree ferns are common, and the hill cane (*Plectocomia himalayana*) forms dense thickets.

What is the degree of prevalence and destructiveness of fires in these forests?

(ii) *Oak and Magnolia Forests of Sikkim.*—These forests begin at an elevation of about 6,000 feet, and are composed of a dense tall growth of oaks and magnolias, mixed with *Castanopsis rufescens*, *Machilus odoratissima*, *Phœbe lanceolata*, an *Actinodaphne*, *Echinocarpus dasycarpus*, *Acer Campbellii*, *Rhododendron arboreum*, *R. argenteum*, *Andromeda ovalifolia*, &c., &c. The oaks are *Quercus lamellosa*, by far the commonest, *Q. annulata*, *Q spicata*, *Q. acuminata*, *Q pachy-*

phylla and *Q. fenestrata.* Of the magnolias the principal are *Magnolia Campbellii* and *Michelia excelsa, lanuginosa,* and *Cathcartii.* The undergrowth is dense and consists of *Strobilanthes,* ferns, &c., and, on the higher slopes, of the *Mayling* bamboo (*Arundinaria racemosa*), which occurs gregariously in dense thickets preventing the growth of other vegetation.

Is herbage abundant? Do fires ever occur? If so, are they destructive?

(iii). *Oak and Magnolia Forests of Burmah and Assam.*—The following is a description of the Burmese subtype condensed from KURZ'S "Forest Flora of British Burma":—These forests begin at about 3,000 feet and reach the topmost limit of tree vegetation in Burmah. The atmosphere is characterised by great dampness. The species are very numerous; the principal are several species of oak (*Quercus fenestrata, spicata, Brandisiana, semiserrata,* &c.); of *Castanopsis* (*C. indica, tribuloides, Falconeri, diversifolia, &c.*; of magnolias (*Ilicium,* &c.); and of rhododendron (*R. arboreum, formosum* and *moulmeinense*), *Ternstræmia japonica, Eugenias, Myrica sapida, Vaccinia, Bucklandia populnea, Symplocos, Andromeda ovalifolia, Cornus oblonga,* laurels, *Dillenia aurea, &c., &c.* Among these grows a fan palm (*Chamærops khasyana*) and a climbing *Plectocomia.* The undergrowth is very dense, especially when light has free access, and consists of bracken, *Rubus,* Gentians, Sundews, *Senecio, Lobelia, Galium,* &c. *Arundinaria elegans* forms a very dense undergrowth in places, and the trees are covered with epiphytic ferns and orchids, *Cyrtandraceæ,* &c., interwoven with mosses and lichens.

Information required regarding the prevalence and severity of forest fires.

(iv). *Pinus Khasya Forests of Burmah and Assam.*—These forests are found in Burmah above an elevation of 3,000 feet, and in Assam between 2,000 and 6,000 feet. In Burmah this pine grows pure or very nearly pure, except in deep gullies and valleys, where it is mixed with a large proportion of broad-leaved species, or is sometimes entirely absent. The pine generally towers above the other trees, often attaining a height of 200 feet, whence its gregarious character.

What are the broad-leaved species mixed with this pine in Burmah? What is the nature of the undergrowth, shrubby as well as herbaceous? What is the frequency and severity of forest fires? For Assam information on every point is wanting.

(v). *Forests of Pinus longifolia.*—This type of Evergreen Forest is extensively represented throughout the Himalayas from the Indus to Bhutan. It enters the Moist Zone, but only in patches, and continuous stretches of it are found chiefly or solely in the Intermediate Zone. It is confined to warm dry slopes and to free soils that are mainly silicious. It is, generally speaking, limited between 4,000 and 6,000 feet of

altitude. The pine is usually all but pure, but *Quercus incana* frequently forms, over limited areas, from 5 to 10 per cent of the crop, exclusive of course of the deeper ravines and any moist slopes where the pine disappears. The Valuation Survey of 17,000 acres, including the dampest localities, round Ranikhet gives an absolute proportion of seven of pine to two of oak. These forests are generally very open, as the pines never, except in their youth, join crowns. The undergrowth consists of barberry, *Cratægus Pyracantha*, holly, wild pear, laurels, species of *Celastrineæ*, *Caprifoliaceæ*, *Cornaceæ*, and straggling growth, such as roses, brambles, &c. The grass is usually spare and short, never rising above three feet. Forest fires are an annual occurrence, and are very severe owing to the thick layer of needles that covers the ground; but the flames very rarely rise high enough to scorch the foliage of trees above the middle size. Usually the fire burns off the leaves only of saplings, its progress is comparatively slow, and the only sign by which a recently burnt forest can be recognised at a distance is the blackened soil. It is a remarkable fact that *Pinus longifolia* at Naini Tal is unquestionably a deciduous tree.

(vi). *Temperate Oak and Rhododendron Forests of the Western Himalayas.*—This type of Temperate Forest occurs in more or less large patches or belts generally interspersed between stretches of forests of *Pinus longifolia*, of cypress, of box, of deodar and its allies, and of *Pinus excelsa*, beginning at 4,000 feet and going up to 8,000 and sometimes 8,500 feet. Moisture is essential to its existence. It thus occupies chiefly northerly and north-westerly slopes and all ravines and deep gullies, and also takes possession of the higher southerly, easterly and westerly slopes in the Moist Zone of the outer Western Himalayas. The oaks and rhododendrons are mixed with numerous other trees, chiefly broad-leaved, of which *Andromeda ovalifolia*, *Machilus odoratissima*, mulberry, ash, *Viburnums*, species of *Cornus*, *Rhamnus* and *Euonymus*, birches, alders, willows, hollies, honeysuckles, hornbeams, Maples, *Rhus*, *Pyrus variolosa* and *Symplocos cratægoides* are the principal. The species of oak that grow in these forests are, beginning with the lowest, *Quercus annulata* ascending up to 5,000 feet, *Quercus incana* between 3,000 and 8,000 feet, *Quercus Ilex* above 6,500 feet, *Quercus dilatata* above 4,500 feet, *Quercus semecarpifolia* above 6,500 feet, and *Quercus lanuginosa* in a few isolated patches between 7,000 and 8,000 feet. All these oaks are more or less gregarious, notably so *Quercus semecarpifolia** and *Quercus incana*. The growth, wherever it has been unmolested, is extremely dense, with a close undergrowth of small shrubs such as *Daphnes*,

* *Quercus semecarpifolia* forest is described as a separate type under Deciduous Forests.

Cotoneasters, roses, brambles and species of *Saxifrageæ*. *Arundinarias* are also very common, and in open places *Indigoferas* and *Desmodium* form impenetrable thickets. Although this type of forest has been classed as evergreen, still most of the companion species are deciduous, as also *Quercus semecarpifolia* itself. Three palms occur in these forests—at lower elevations, *Wallichia densiflora* and *Chamærops Ritchieana*, both low shrubs, and the former forming frequently a dense undergrowth; between 5,000 and 8,000 feet, in dense forest, and in large numbers, the tall and graceful *Chamærops martiana*.

Owing to the moist nature of the localities occupied by these forests, and the closeness of the growth, fires are a rare occurrence, do comparatively little damage, and are easily extinguished.

(*vii*). *Box Forests.*—These are mixed forests occurring in small scattered patches in the Suleiman and Salt Ranges, and in the Western Himalayas between 4,000 and 8,000 feet, and in Bhutan from about 6,000 to 7,000 feet. They hardly deserve being raised into a distinct type but for the extremely valuable nature of the wood of the Box. The Box is gregarious.

Messrs. Bagshawe, Moir, Smythies and Hearle, and other gentlemen who are familiar with forests of Box, are invited kindly to publish their experiences.

(*viii*). *Cypress Forests of the Western Himalayas.*—This type of forest occurs over limited areas, between 5,500 and 8,500 feet, in various portions of the outer Himalayan ranges from Chamba to Nepal, on or in the vicinity of limestone rocks, and generally, but not always, on very steep, dry, warm rocky, slopes. The cypress is, of course, the predominant tree, associated, according to the locality, with deodar, the Himalayan spruce and silver firs, and oaks, or with oaks alone. These oaks are *Quercus incana*, *dilatata*, and *semecarpifolia*, and, where they find favorable conditions, they fill up the intervals between the slender and loftier crowns of the conifers, and thus help to form a very complete leaf-canopy. The undergrowth consists of barberries, *Rhododendron arboreum*, species of *Caprifoliaceæ*, *Saxifrageæ*, *Euonymus*, *Cornus*, *Ilex*, laurels, *Symplocos*, *Cratægus*, willows, &c., and undershrubs such as *Rubus spp.*, *Daphne papyracea*. *Indigofera*, *Spiræa*, &c. Herbaceous species, *Rumex*, *Potentilla*, ferns, &c., cover the soil. Owing to the generally damp and cold climate, and the absence of any considerable quantity of combustible matter, fires are rare, and do little damage.

(*ix*). *Forests of Deodar and its Allies.*—This type of Temperate Evergreen Forest is found in India in the Western Himalayas between 66° and 81° East Longitude, from a point

about 40 miles east of the Niti Pass* westwards to the boundary of Afghanistan. Generally speaking, it begins at 4,000 feet, and ascends up to 10,000 feet, and is mainly represented in the basin of the chief tributaries of the Indus, on the Tons, Jumna and Bhagirathi rivers, and on three or four feeders of the Alaknanda and Kali Ganga. As regards rainfall it extends from the edge of the moist to the vicinity of the arid zone. In the forests of this type the deodar alone covers large areas, or is associated with *Pinus excelsa* and *Abies Smithiana*, less commonly with *Abies Webbiana*, and the three oaks, *Quercus incana*, *dilatata* and *semecarpifolia*. The cypress, birch, yew, and, in Kunawar and Pangi, *Pinus Gerardiana*, are also companions of the deodar. The true deodar forests occupy the middle ground between warm well-lit southern slopes on which the *Pinus excelsa* grows almost pure, and cold moist northerly slopes where the *Abies Smithiana* forms the predominating tree. Other trees are maples, alder, *Celtis*, ash, walnut, mulberry, *Pistacia*, poplars, elms, &c. The undergrowth consists of hollies, barberries, species of *Cornus*, *Rhamnus*, and *Lonicera*, roses, brambles, *Viburnums*, willows, *Arundinarias*, *Desmodium*, *Indigoferas*, yew, hazel, &c.

What is the frequency and severity of forest fires?

(*x*). *Pinus excelsa Forests of the Western Himalayas.*—These forests begin on the edge of the moist zone and extend inwards, through the intermediate belt, into the arid zone. Although the *Pinus excelsa* itself is found as low down as 5,000 feet, and as high as 12,500 feet, still the type of forest here referred to ranges only between 6,000 and 10,000 feet. Unlike its long-leaved congener, this pine does not form pure forests of large extent, but is generally mixed, according to the elevation in any particular case, with *Pinus longifolia*, deodar, the silver and spruce firs, and *Betula Bhojpattra*. The growth is generally lofty, surmounting an under-story of the same shrubs and small trees as occur in deodar forest. Owing to the drier and more open nature of *Pinus excelsa* forest, fires are more general and destructive than in the last described type.

(*xi*). *The Nilgiri Forests.—Information wanting as to nature of growth (including undergrowth), as to whether they comprise more than a single well-defined type, and as to the prevalence and severity of fires.*

8. ALPINE EVERGREEN FORESTS.—This subclass of forests may, in a general manner, be said to begin at about 8,000 feet, and to extend to the upper limit of tree vegetation; but, as has already been noticed in the description of the types of the preceding subclass, no hard and fast line can be drawn between the two. The deodar and *Pinus excelsa* types run

* The eastern limit of deodar here given was ascertained by an exploring party I sent to Nepal last summer.

up into the zone of truly Alpine forests, and the Temperate oak type fades insensibly into the corresponding Alpine type, which is, however, deciduous (*Quercus semecarpifolia*). These Alpine Evergreen Forests are situated partly in the intermediate zone of moisture, but chiefly in the arid zone beyond. I have no personal acquaintance with these forests, and the literature in which they are described from the forester's point of view treats of them too vaguely to enable me to divide them into characteristic types. We may, however, distinguish them tentatively, and quite provisionally, into the following types :— (i) Rhododendron Forests of the Eastern Himalayas; (ii) Alpine Conifer Forests of the Eastern Himalayas; (iii) Silver Fir Forests of the Western Himalayas; (iv) Juniper Forests.

(i). *Rhododendron Forests of the Eastern Himalayas.*—From Mr. Gamble's description of these forests in Sikkim it would appear that the vegetation is composed chiefly of various species of rhododendron, the more common of which are *R. Campbellii, R. Falconeri, R. barbatum* and *R. arboreum.* Associated with the rhododendrons are *Betula Bhojpattra* (deciduous), several kinds of maples (also deciduous), *Andromeda ovalifolia, Hydrangea altissima,* the yew, &c. For the forester, this type possesses little importance except as local sources of supply of fuel.

Do fires ever occur ?

(ii). *Alpine Conifer Forests of the Eastern Himalayas.*— These forests consist principally of the Himalayan silver fir (*Abies Webbiana*), associated with a large proportion of *Abies dumosa* and *Juniperus recurva.*

Does Larix Griffithii occur in these forests as a companion species, or is it gregarious enough to form a distinct type of Alpine Deciduous Forest ? What is the nature of the undergrowth ? Do fires ever occur ?

(iii). *Silver Fir Forests of the Western Himalayas.*—These are extensive forests of *Abies Webbiana,* pure or mixed with maples, rhododendrons, oaks (*Quercus dilatata* and *semecarpifolia*), *Betula Bhojpattra, Abies Smithiana, Pinus excelsa,* &c. They sometimes ascend as high as 13,000 feet. The purest forests are found on cold northerly or westerly aspects.

Do these forests extend into the Arid Zone ? What is the composition and character of the undergrowth ? Is the leaf-canopy always very dense ? Do fires ever occur ?

(iv). *Juniper Forests.*—These forests occur at very high elevations, often forming the upper belt of tree vegetation. They range generally between 9,500 and 15,000 feet, and extend into the heart of the Arid Zone. In the Western Himalayas *Juniperus communis* and *J. recurva* form extensive patches or belts, either pure or mixed together, of low forest on dry bleak, often rocky slopes. The latter species, like the

large juniper *(J. Wallichiana)* continues eastwards to Sikkim, but ceases to be gregarious.

Is the growth dense? What is the nature of the herbage or other undergrowth?

9. SANDALWOOD FORESTS.—*Does the Sandalwood tree form a sufficiently large proportion of the forests in which it grows to permit of its being raised into a separate sub-class? If so, would Major Van Someren or Mr. Hutchins kindly favour us with descriptions of these forests, which they know so well?*

SECTION II.—DECIDUOUS FORESTS.

1. FORESTS OF COLD WEATHER LEAF-SHEDDERS.—In this subclass of forest the majority of the trees shed their leaves in the cold season or soon after the South-West Monsoon has ceased, the rest being either evergreen, such as *Abies Webbiana*, rhododendrons, junipers, yew, *Mimusops indica*, *Pongamia glabra*, &c., or, in the great majority of cases, hot weather leaf-shedders such as khair, *Anogeissus latifolia*, *Ulmus integrifolia*, &c. Three principal types of these forests may be noted, *viz.*, (*i*) Sissoo Forests in Northern India, (*ii*) *Boswellia thurifera* Forests in Central India and the Deccan up to within 20 miles of the Western Ghats, and (*iii*) Alpine Birch Forests.

(i). *Sissoo Forests.*—This type occurs mostly on silty sand or gravel along the banks and on the islands of Himalayan rivers, extending from some point a few miles above where they issue out of the hills down to from 50 to 100 miles in the plains. The sissoo is often pure or very nearly pure in it. The leaves of this tree fall in November—December. Its most frequent companion is khair, which sometimes forms as much as 10 per cent of the crop and loses its leaves soon after the end of the cold weather. Other allied species are *Ligustrum robustum*, *Albizzia stipulata*, *Julibrissin* and *Lebbek*, *Cedrela Toona*, *Bauhinia racemosa*, species of *Ficus*, *Spondias mangifera*, *Ulmus integrifolia*, *Premna mucronata*, *Bombax malabaricum*, *Zizyphus Jujuba*, &c. The growth is generally open, but is occasionally dense enough to kill out all herbage below. The undergrowth, as is to be expected in sandy soils, consists chiefly of coarse spare herbage, sometimes attaining a height of 8 feet, but more commonly not exceeding 3 feet. In consequence of this and of the generally moist nature of the sissoo localities during the greater part of the year, forest fires, although generally annual, are usually not severe.

(ii). *Boswellia thurifera Forests.*—This second type of forests of cold weather leaf-shedders is most extensively represented on the hot, dry, compact sandstone hills of Vindhyan formation along the upper and middle course of the Narbada and its tributaries, on the drier ridges and spurs of the Sathpuras, on the arid hills of the Deccan to within 20 miles of the Western Ghats, and on silicious soils in the upper basins of the

Mahanadi and Son rivers. A patch of about two square miles is also found on the southern face of the Siwaliks west of Hardwar on the Ganges. The *Boswellia* is sometimes quite pure, especially in ferruginous soils; but, as a rule, it surmounts a sparse stunted undergrowth of other species, usually hot weather leaf-shedders, such as khair, teak, *Pterocarpus Marsupium*, *Anogeissus latifolia*, *Sterculia urens*, &c., which are elsewhere large or at least middle-sized trees. In Nimar, in Central India, and in a few other places *Hardwickia binata* shares a not inconsiderable place in the leaf-canopy with it. Occasionally *Dendrocalamus strictus* and *Buchanania latifolia* are also associated with it. There is often a shrubby undergrowth of *Nyctanthes Arbortristis*, and *Symphorema involucratum*. The *Boswellia* is quite leafless by the middle of December, and does not renew its foliage until the end of June. Moreover nearly all its companions are also bare early in the hot weather. The appearance of the forests is, therefore, extremely bleak and desolate throughout the hot weather. The trees usually stand apart, and the foliage of the *Boswellia* is never dense. There is hence always a more or less heavy growth of grass, although the poverty or absence of dicotyledonous herbage is remarkable. After what has been said, it is obvious that conflagrations are an annual plague and their effects are aggravated by the dry ungrateful nature of the soil and climate, which is rendered still more dry and barren by the reaction of the fire on them. Since the *Boswellia*, under the most favourable conditions, forms only an open or interrupted leaf-canopy, we have only to keep out fire continuously in order to improve the soil and the growth and proportion of the companion species, many of which would then rise up on a level with the *Boswellia*, and ultimately form a large and valuable integral portion of the crop.

(iii). *Alpine Birch Forests.*—These forests are found in the higher ranges of the Himalayas, extending far into the Arid Zone. Their lowest limit is, in the Panjab, at 7,000 feet, in Sikkim, not under 9,500 feet. They ascend commonly to 11,000 feet, often to 12,000 feet, and sometimes, as in inner Sikkim, to 14,000 feet, and are most frequently met with on northerly and westerly aspects. The Indian Alpine Birch (*Betula Bhojpattra*) grows there almost pure, and, as it sheds its foliage in October, and does not renew it until the following April or May, these forests are leafless during half the year.

What are the allied species? What is the composition and character of the undergrowth? Do fires ever occur?

2. FORESTS OF HOT WEATHER LEAF-SHEDDERS.—In this subclass of Deciduous Forests the majority of the trees lose their leaves in the hot season. It is much more extensively distributed than the preceding one. It presents numerous types, of which, however, I will note only the following ten,

which seem to be the most important :—(i) *Quercus semecarpifolia* Forests of the Western Himalayas, (ii) Sal Forest, (iii) Mixed Forests in which teak is present, (iv) Mixed Forests without teak, (v) Eng Forest, (vi) *Acacia Catechu* Forest, (vii) *Hardwickia binata* Forest, (viii) Bamboo Forest, (ix) *Anogeissus pendula* Forests, and (x) *Malanorrhœa usitata* Forests.

(i). *Quercus semecarpifolia Forests of the Western Himalayas.*—This type of forest occurs in large patches in the Moist and Intermediate Zones, beginning at about 8,000 feet and ascending to 12,000 feet, not unfrequently forming the upper limit of arborescent vegetation. This oak is gregarious, and often forms a pure growth over considerable areas. Otherwise it is associated with a varying proportion of maples, *Rhododendron arboreum, Betula Bhojpattra* and *acuminata*, &c. The leaf-canopy is generally dense and then admits of only a light undergrowth of species of barberry, *Rhamnus, Euonymus, Lonicera, Viburnum, Ribes, Pyrus*, brambles, &c., with a herbaceous ground-covering of *Potentillas, Spiræas*, Ferns, &c., &c. Where the forest is open, *Arundinaria falcata*, and, at lower elevations, also *Indigofera heterantha* and *atropurpurea*, form a dense undergrowth. Owing to the damp climate, the all but evergreen leaf-canopy and dense covering of shrubs and herbs, fires are very exceptional occurrences.

(ii) *Sal Forest.*—In this the second type the sal is always the predominant tree, sometimes growing almost pure, otherwise associated with *Terminalias, Lagerstræmia parviflora, Dillenia pentagyna, Buchanania latifolia, Semecarpus Anacardium, Anogeissus latifolia, Bauhinias, Dendrocalamus strictus, Ougeinia dalbergioides, Eugenias, Murrayas*, laurels, species of *Ficus, Wrightias, Albizzias, Wendlandias, Pinus longifolia, Bombax*, &c.

The forests of this type form two irregular but fairly defined belts separated from one another by the Gangetic plain. The Northern or Sub-Himalayan belt extends from Assam to the Kangra Valley in the Panjab, skirting the foot of the hills and descending into the doons and valleys, and ascending in places, as near Naini Tal, to 4,400 feet. Near the western end of this belt the sal forests are less extensive, and terminate near the Beas river in a number of scattered patches of limited area. There are no sal forests in the plains west of the Ganges; while east of that river, in Rohilkhand, Oudh, Gorakhpur, and Bengal, such forests occur at a considerable distance, sometimes 100 miles, from the hills. The second, or Central Indian, belt occupies the hilly country of Behar, Rewah, Sirgooja, Chota Nagpur, Midnapur and the Maikal range of hills between the Narbada river and the open country of Raipur, extending south to the upper basins of the Indravati and Severy (both tributaries of the Godaveri) to the upper basin of the Mahanadi, and into the Northern Circars. An outlier of this belt

occurs on the sandstone hills of the Pachmarhi range, and in the valley of the Denwa. Sal forests are never found in a thriving state off free, water-transmitting soils. When they occur on stiff clays, as in many parts of Oudh, Kumaon and the Dehra Dun, the trees are generally dwarfed and seldom attain a large girth. Their range of distribution is limited and determined by the hot and dry winds of the Gangetic plain, of the Punjab, of Bundelkhand, and of the Malwa plateau, by the Central Indian trap country, and by the excessive moisture east of Tezpur in Assam.

Although this type of forest has been classed as deciduous, still the sal, which is the main tree, is in the moister localities seldom quite leafless, the new flush of leaves coming out as the old foliage is shed.

The growth is, as a rule, lofty and dense, and, with protection, is always close enough to kill out grass. Indeed the stool of the young sal is so vivacious, that even under the *régime* of annual fires it strengthens itself every year until it is able to throw up a master-shoot which, if not entirely proof against fire, is still burnt down only for a portion of its length and is ultimately able to rise up above its influence. The result of this, combined with the tendency of sal to form a complete leaf-canopy, and its affecting soils where the grass generally remains green or at least moist, and nightly dews prevail up to the middle or even the end of May, is that, with few exceptions, sal forest is to a great extent self-protected against fire. Our present forests of this type are, however, in so ruined a state that they are interspersed or surrounded with glades and blanks, in which the growth of grass is rank and high and makes partial conflagrations an annual occurrence. Such conflagrations are necessarily very severe, but the area over which they rage is becoming every year smaller as the forest encroaches on the grass land.

(iii). *Mixed Forests in which Teak is present.*—This second and extremely important type is distributed in India proper south of a line beginning at the mouth of the Narbada, running north-east below Mhow and Bhopal, thence turning north past Saugor to Jhansi, and finally from latitude 25° 30′ North sweeping round in a south-easterly direction by Jabalpur and Mandla to the Mahanadi river in Orissa; and in Burmah south of the 25th parallel of North Latitude.

In India proper there is little doubt that its northern limit from the Narbada to Jhansi and Jabalpur is determined by the low temperature of the winter months in the country outside that line, while its spread further northward elsewhere, is prevented by the greater suitability of the climate and soil for species which prevail over the teak in the struggle for existence, notably sal. It flourishes on sandstone, but it is also largely spread over more or less binding soils provided

the drainage is sufficiently free. In Burmah this type of forest ascends to 3,000 feet, in the northern portion of its range in India proper up to 3,500 feet, and in the Peninsula up to a little above 4,000 feet; but generally the growth of teak becomes stunted above 2,000 feet in Burmah and in the northern portion of its habitat in India, and about 3,000 feet in the Indian Peninsula. In Central India the growth of that species is unpromising except in a few isolated localities, as in the Ahiri Zamindari in the Chanda District, in places in Bastar, &c.

In this type of forest the proportion of teak to its associates is very variable. On alluvial soils and on the rolling trap hills of the Sathpurns, wherever extraneous circumstances, such as *Dhaya*, have driven out or kept back the other species, the teak is almost pure. Elsewhere, according to fluctuations in the nature of the soil and subsoil, and to change of aspect and locality, it is either entirely absent over several acres and even one or more square miles, or appears in patches of several individuals together; but in any case, when a sufficiently large area is considered, its proportion scarcely ever exceeds 1 in 10, and is generally not more than 1 in 100. The associates of teak are, besides bamboos, the ordinary trees of the dry tracts of India. These of course vary in different parts, but the following kinds may be regarded as its usual companions:—*Ougeinia dalbergioides, Anogeissus latifolia, Diospyros Melanoxylon, Terminalia tomentosa, Dalbergia latifolia, Pterocarpus Marsupium, Lagerstræmia parviflora, Gmelina arborea, Schleichera trijuga, Cassia Fistula, Terminalia belerica, Buchanania latifolia, Semecarpus Anacardium, Garuga pinnata, Sterculia, Eriolæna, Cordia, Adina cordifolia, Careya arborea, Bauhinias*, &c., &c. To these must be added, in Burmah and some of the forests of the Peninsula, *Pterocarpus indicus, Xylia dolabriformis, Anogeissus acuminata*, &c.; in some parts of Central and Southern India, *Hardwickia binata*; and for the whole of Central India, the Deccan, and some portions of the Peninsula, *Boswellia thurifera*.

The following is a brief recast by Mr. Baden-Powell of the four subtypes of Burmese Teak Forest established by Dr. Brandis in his Attaran Report:—

(*a*). *Position.* Level, below hills or in valleys near higher hills as Beeling (Martaban).

Soil. Moist, good.

Companion species. Very various: *Lagerstræmia Flos-Reginæ* and *tomentosa, Dillenia, Bignonia*, &c., &c., and bamboos.

Undergrowth. Musa, Zingiber, Curcuma, Globba, and Acanthaceous plants.

Shade in Hot Season. Constant.

Fires. Not regular; not dangerous.

(*b*). *Position.* Lower undulating hills.
Soil. Moist, good.
Companion species. Bamboos in scattered clumps, *Xylia*, *Pterocarpus*, *Albizzia*, *Terminalias*, *Dillenia speciosa*, *Hibiscus*, *Bombax* and *Eriodendron*.
Undergrowth. Pollinia or Teak Grass, which dries and becomes inflammable.
Shade in Hot Season. Some.
Fires. Regular, destructive.
(*c*). *Position.* Lower undulating hills.
Soil. Poor and dry.
Companion species. Dendrocalamus strictus, Hibiscus, Xylia, Terminalia, &c.
Undergrowth. Little or none.
Shade in Hot Season. None.
Fires. Regular, but sparse undergrowth renders them light.
(*d*) *Position.* Higher hills.
Soil. Slopes with good soil.
Companion species. Evergreen Bamboos, *Xylia, Homalium, Terminalia.*
Undergrowth. Rather sparse; in places Acanthaceous plants, *Baliospermum*, &c., and Grass.
Shade in Hot Season. Some.
Fires. Occasional only, and not very destructive.

In India most of the companion species in this type of forest are leafless during the whole of the hot weather, while the growth is generally more or less open and the ground is hence nearly always covered with a close crop of grass from 1 to 12 feet high, which, owing to the dryness of the soil, becomes easily inflammable very early in the year. Moreover the pile of newly-fallen dead leaves on the ground is every year more than a foot thick and is highly combustible. The consequence is that, except where protection is specially undertaken, fires sweep annually through every square inch of the forest, burning up all the grass and the thick covering of fallen leaves, seeds and debris of branches, thus preventing natural reproduction, impeding the formation of humus, hardening, caking and baking the surface soil, and destroying or fatally injuring a large portion of the standing growth.

(iv). *Mixed Forests without Teak.*—This type of Deciduous Forest forms the connecting zone or link between Teak Forest, on the one side and *Hardwickia, Acacia Catechu*, Bamboo, Eng and especially Sal and the first, six, and ninth subclasses of Evergreen Forests on the other. Forests of this type vary greatly in their constituent species, which are, however, the same as those of the two types just described. Their limit is determined by the frequent inability of teak to extend itself, in numbers sufficient to form an integral portion of the crop, right up to the confines of Deciduous Forests of the remaining types

and of the Evergreen Forests already mentioned. Hence, as a rule, they occur only in patches or belts of limited extent separating Teak Forests from the rest. One of the largest of these areas, an exceptionally extensive one, is the Moharli *Pterocarpus Marsupium* tract in the Central Provinces, which measures about 400 square miles. As is natural to expect, they offer many subtypes according to the prevailing tree, which in one case is *Pterocarpus Marsupium;* in a second, *Ougeinia dalbergioides*; in a third, *Anogeissus latifolia;* in a fourth, *Terminalia tomentosa;* and so on.

On stiff binding soils *Terminalia tomentosa* forms under favorable circumstances a dense lofty leaf-canopy tolerating no undergrowth of any kind, and such patches are self-protected against fire to the same extent as Sal Forest. Otherwise fires are an annual visitation; but the injury done by them varies greatly with the predominant species, being, for instance, comparatively slight in tracts of *Ougeinia dalbergioides* and very severe in those of *Pterocarpus Marsupium* and of *Anogeissus latifolia.*

(v). *Eng Forest.*—This type is peculiar to Burmah and is so named after the principal tree in it, the ENG (*Dipterocarpus tuberculatus*). It has been divided by KURZ into two subtypes as follows:—

(*a.*) *True Eng Forest.*—This subtype occurs entirely on laterite on flat or undulating ground, and is marked by the complete absence of teak from it. The Eng is, of course, the predominant tree, but associated with it are *Dillenia pulcherrima, Shorea obtusa, Pentacme siamensis, Lophopetalum Wallichii, Zizyphus Jujuba, Buchanania latifolia, Melanorrhœa usitata, Symplocos racemosa, Diospyros birmanica, Dalbergia cultrata, Wendlandia tinctoria, Terminalia macrocarpa, Careya arborea, Strychnos Nux-vomica, Odina Wodier, Gardenia turgida, Eugenia Jambolana,* &c. *Dendrocalamus strictus* puts in an appearance, but only on the outskirts of the forest. Climbers are remarkable by their almost total absence. Shrubby and herbaceous growth is meagre and sparse. Where depressions occur, they are usually covered over with deposits of stiff clay inundated during the rains and more or less covered with thin grass and sedges. Fires occur annually, but, owing to the comparatively small quantity of combustible material on the ground, are not very destructive.

(*b.*) *Hill Eng Forest.*—This subtype occupies the ridges of the outer hills of Martaban and Upper Tenasserim, where they luxuriate either on laterite formed by the decomposition of the underlying rock or on débris of metamorphic rocks. In general aspect this subtype agrees with the one just described. But the Eng is often replaced or intermixed with *Dipterocarpus costatus,* and *obtusifolius,* and some other trees are met with such as *Engelhardtia villosa, Quercus Brandisiana* and *Bancana, Schima Bancana, Castanopsis tribuloides,* &c.

What is the nature of the undergrowth, and the prevalence and destructiveness of fires?

(vi). *Khair Forest.*—Forests of *Acacia Catechu,* associated frequently with sissoo, but more or less pure, are found in the Sub-Himalayan belt on islands and on the banks of streams near their entrance into the plains from the Indus to Assam.* The tree forms more or less pure forests also on dry sandstone hills in Central India and on alluvial soils at the foot of the hills in the Prome and Thayetmyo Districts in Burmah. In the Sub-Himalayan tract the growth under favorable conditions is at least fairly dense. This fact, combined with the nature of the soil (sandy and extremely wet during the season of vegetation), accounts for the usually very short and spare crop of grass and other undergrowth in these forests, and the infrequency and light character of fires. In Central India the growth is very open and stunted and the crop of grass comparatively heavy, with the result that very destructive fires occur annually, which render the khair crooked, shrubby and unsound.

Information required regarding the Sha tracts of Burmah. (Messrs Oliver and Pickard.)

(vii). *Hardwickia binata Forest.*—This species forms long belts or patches of greater or less extent of forest in some of the drier tracts of South and Central India. One great belt extends from a point west of Indore through Dhar, Nimar, Khandesh, Berar, Chanda and the Godaveri Forests into the Circars. Patches occur on the eastern slopes of the Pachmarhis, near the Dudhi river, on the Singroli hills south of the Sone River, and in Northern Mysore. Everywhere in this type of forest the *Hardwickia* is easily the predominating tree; but as it forms of itself very open growth, and throws little shade, there is always a certain proportion of species characteristic of the dry tracts of India associated with it:—*Anogeissus latifolia, Boswellia thurifera, Odina Wodier, Schrebera swietenioides,* teak, bamboo, *Diospyros Melanoxylon, Pterocarpus Marsupium, Soymida febrifuga, Terminalia tomentosa,* &c.

The undergrowth consists chiefly of *Nyctanthes Arbortristis,* which forms dense thickets, *Acacia Catechu, Mimosa rubicaulis, Gardenia turgida* and *lucida, Zizyphus xylopyra, Randia dumetorum, Celastrus senegalensis, Flacourtia Ramontchi, Kydia calycina, Helicteres Isora, Cochlospermum Gossypium, Balanites Roxburghii* and *Grewia pilosa* and *asiatica*; and the undershrubs *Grewia polygama* and *Desmodium gangeticum* are very common. The growth of grass is very variable, being from dense and rising up to a height of 8 feet on the richer and deeper soils to rather spare and from only 9 inches to 2 feet high in dry rocky situations. This grass dries up between October and February, and all the companion species shed

* See footnote to page 373.

their leaves within the same period, and do not renew them before the middle or end of June. Thus fires rage from October to the commencement of the rains and are very destructive.

(viii). *Bamboo Forest.*—This type is largely developed in Burmah, in Eastern Bengal and in Assam, and partially in Central India and in the Peninsula. It is characterised by great uniformity of aspect and by the poverty of the undergrowth, shrubby as well as herbaceous, due to the dense leaf-canopy above and the invasive nature of the root apparatus of the bamboos. We seldom find more than two kinds of bamboo together, and we thus have subtypes according to the prevailing species, after which they may be named. Single species frequently cover enormous areas, as for example in the Garo Hills, where, out of an area of 600 square miles, at least half is covered by the "Terai Bans," which forms the densest growth imaginable, occasionally reaching a height of 40 feet. On a very much smaller scale the Kattang (*Bambusa arundinacea*) and the *Dendrocalamus strictus* form patches or belts of from ½ to 15 squares miles of more or less pure forest in the North-West Provinces, in Oudh and in Central India.

As in each bamboo clump some shoots die every year, and the layer of dry fallen leaves is very thick, there is always a large quantity of highly combustible material in these forests, which renders fires an annual and very destructive visitation. But when the gregarious flowering begins and the clumps die off wholesale, the fires become quite uncontrollable and the whole crop of seed is sometimes destroyed.

The species sometimes associated with the bamboos vary according to the locality, but are generally the same as those which grow in the neighbourhood and belong to the types of forest already described.

When the bamboos have seeded and died off simultaneously over a large area, numerous seedlings of hardy shrubs and trees spring up with the bamboo seedlings and contend with these latter for supremacy, and not unfrequently gain the upper hand, keeping down the bamboos as an undergrowth.

(ix). *Anogeissus pendula Forests.*—This type consists of large stretches of almost pure forests of *Anogeissus pendula* (*Dhaukra*) clothing the dry submetamorphic hills of Ajmir and Marwar, of Mewar, Bassi, Chitor, Bundelkhand, &c. The principal companion species are khair, *Bauhinia racemosa*, *Boswellia thurifera*, *Ehretia lævis* and *obtusifolia*, *Dalbergia lanceolaria*, *Anogeissus latifolia*, *Euphorbia Nivulia*, &c.

The growth is under favorable conditions, as a rule, extremely dense and bushy, and seldom exceeds 35 feet in height. The shrubby undergrowth consists of several small species of *Grewia* (*villosa*, *populifolia*, *salvifolia*, *asiatica*, and *pilosa*) *Rhus mysorensis*, *Plumbago zeylanica*, &c. The crop of grass in the

glades and blanks is short and spare, and dries up by November. Fires there are hence regular occurrences, and, in spite of the light growth of the grass, are extremely severe owing to the long dry season and the high temperature of the hot season They are also severe in the close-grown portions, as the *dhaukra*, being very nearly pure and out of leaf from April—May to the first week of the rains, the ground gets covered in the hot weather with a thick covering of dry leaves, which burns up fiercely when ignited, the fire rising to the top of the low-crowned trees and killing and injuring innumerable buds, twigs and branches. Under these circumstances it is uncommon, in spite of the profuse annual seeding of the *dhaukra*, to find any noticeable quantity of young reproduction, and the trees grow stunted and branchy.

(x.) *Melanorrhœa usitata Forests.*—This has been suggested to me as a type by a Forest Officer from Burmah. As I have no experience whatsoever of that province, would foresters there kindly favour me with a brief description of the type in question, bringing out all its main characters?*

CHAPTER IV.—*Creation and Regeneration of Forests,*

SECTION 1.—DEFINITIONS.

A forest may be created or regenerated either ARTIFICIALLY or NATURALLY, or by both means combined—ARTIFICIALLY by means of DIRECT SOWING or PLANTING, NATURALLY by means of SELF-SOWN SEEDS, STOOL-SHOOTS or SUCKERS.

In DIRECT SOWING, as the term implies, the seed is placed in the ground in the forest itself which is to be created or regenerated, and at the very point which the seedling is finally to occupy.

PLANTING may be distinguished into PLANTING PROPER, and PLANTING with SLIPS and LAYERS, SUCKERS and RHIZOMES.

In PLANTING PROPER seedlings raised at, and brought from, some other point are used in the place to be stocked.

A SLIP † is a severed branch or stem, a certain or the whole length of which is put into the ground where it strikes root. SLIPS may either, like seeds, be placed out at once

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* The reader will now have seen how necessarily imperfect and sketchy the Notes given in this Chapter are. To do justice to the subject of it would require a long and thorough familiarity, such as no ordinary being could acquire even in a whole lifetime, with the multifarious forest forms of a continent like India, which comprises within itself nearly every imaginable variety of soil and climate. My only hope is that I shall meet with the hearty co-operation of all Indian foresters, whose combined experiences it will be possible to harmonise and embody together when the present Chapter comes to be finally written. I address my appeal more especially to Southern India, which is as yet a completely unknown land for me.

† The term more generally in use is "cutting," but this word also denotes felling, or the removal of the whole or a portion of a standing crop. I have hence, to avoid an ambiguous terminology, preferred the less usual noun "slip," from which we derive the verb "to slip," and the noun "slipping" meaning respectively *to propagate by slips* and the *operation of propagating by slips.*

where they are required, or, like seedlings, they may be raised elsewhere and removed thereto only after they have struck root.

LAYERS are also branches, which are, however, at first bent and pegged down into the ground at some point below their growing extremity, or enclosed for a part of their length within a ball of earth, and are severed from the parent stem only after they have struck root.

TO TRANSPLANT means simply to remove a plant from any one place to any other.

A TRANSPLANT is any rooted plant used in planting.

A NURSERY is any area specially set aside for the raising of transplants.

TO PICK OUT a plant is to remove it from one point of the nursery to any other, while to PUT OUT a transplant means to place it in the ground in the forest at the point itself which it is finally to occupy. *To pick out* and *to put out* are thus only two special cases of *transplanting*.

TO UNDERPLANT is to plant under an existing taller crop.

A SEEDBED is any cultivated portion of a nursery in which plants are raised from seed sown *in situ*. Before transplants are put out, they are often removed from the seedbeds and planted out in regular lines in the nursery itself, such lines being termed NURSERY-LINES.

SECTION 2.—NURSERIES.

Whatever method we adopt for the creation or regeneration of a forest deserving of the name, the establishment of a nursery is indispensable. If planting is resorted to, the necessity of a nursery in which to raise the transplants is obvious. However successful natural regeneration may be, however conscientious or skilful the care and precautions taken in executing direct sowings, there will always be spots of less or greater magnitude in which seedlings will die off or refuse to come up, or in which stools will be unproductive, or in which a given valuable species will be absent or insufficiently represented, in which, in short, the early establishment of plants of a certain species and of a given size and vigour will be urgently required. In all these cases a nursery must be at hand from which a supply of such plants is immediately available. In a nursery all the plants receive individual attention, and it is there alone that they can be raised under the most favorable conditions possible for any required purpose. How to establish a nursery is, therefore, the first question that requires to be answered. In doing so, I will consider the subject under the following nine heads :—

(1). Choice of site.

(2). Area of nursery.

(3). The form of its boundary.

(4). Fencing.
(5). Watering.
(6). Preparation of the soil.
(7). Laying out of beds, paths, &c.
(8) Collection and storage of seed.
(9). Preparation and management of seedbeds and nursery lines.

Before proceeding to discuss each of these points separately, it is necessary to premise that nurseries may be either TEMPORARY or PERMANENT according to the purpose which they are to serve. For instance, heavy planting operations are undertaken over a large area, and carriage is expensive; in this case it may be found advantageous to make several temporary nurseries, each to supply the transplants within a certain radius of itself, and to be abandoned immediately afterwards. Or, again, a large blank is to be restocked, near which there is an excellent site for a nursery, but which is situated at some distance from the regular nursery serving the forest; here also it might be profitable to utilize the site in question in order to raise just the number of plants required. And so on.

It is evident that once a nursery is established, it can be maintained indefinitely without any further expenditure on the preparation of the soil, on fencing, and on the supply of means for watering it, except what is necessary for mere repairs. This expenditure is always comparatively heavy, and is incurred once for all in a permanent nursery, whereas it constitutes a fresh charge each time a temporary nursery is made. Moreover a permanent nursery can, for obvious reasons, be managed more efficiently and also more economically. Hence the only advantage which lies on the side of temporary nurseries is reduced cost of transport; and consequently, whenever there is any question of establishing this class of nursery, it must first be proved that the saving on carriage is not more than counterbalanced by what would be gained in efficiency and in reduced charges on the raising of the transplants in a permanent nursery.

§ 1. PERMANENT NURSERIES.

§§ 1. *Choice of site.*

In choosing a site for a permanent nursery, we have to consider its two elements:—(i) soil, and (ii) locality.

With respect to the first, it is an exploded idea that transplants should necessarily be raised in soil similar to that of the forest into which they are put out. What we require is nothing more or less than vigorous plants well furnished with fibrous rootlets and with a crown strong in proportion, and that soil is the best for our purpose which produces such plants, whether it be like the soil of the forest or

not. Such a soil suitable for almost every species is one of a medium quality, which is neither too rich nor too poor, neither too wet nor too dry, neither too stiff nor too free; in other words, it should be a moist sandy loam that is free from stones and sufficiently deep. If it should happen that soil of this character is not available, then it is better to select a sandy soil than one which contains a strong proportion of clay, which in drying would cake at the surface, and shrink and crack, thus rending asunder and killing the roots of the seedlings, and which during frost would swell up and then eject them as soon as thaw occurred. The sterility and want of sufficient cohesion of a sandy soil can be easily cured by admixture of the necessary manures, whereas it would be a difficult and expensive task to correct the defects of stiff clays. Moreover, a sandy soil is much more easily kept clear of weeds. As regards depth it does not follow that because the transplants ought to possess short roots, not exceeding say 18 inches in length, the depth of the soil should also be limited to that figure. With such a slight depth, the soil would nearly always be exposed to be overheated under a hot sun, and it is always safe to insist on a minimum depth of 3 feet. Stones in the soil also tend to overheat it, besides injuring the nursery implements and interfering with the easy lifting up of the plants.

The nature of the subsoil is of little importance as long as it is not impermeable or too freely permeable. A basis of lime is an advantage, as it prevents the formation of acids in the soil, while at the same time it enriches it.

Here I must note the exceptional case of the sissoo plantations recently started by Captain Wood. After several failures in attempts to restock with sissoo certain areas, which are now grasslands interspersed with a few scattered sissoo trees, standing alone or in small clumps, but which formerly bore a good forest of that species, Captain Wood very rightly came to the conclusion that the roots of the sissoo seedlings he put in were unable to cope with the dense mass of roots of the grasses already in possession of the ground. He, therefore, conceived the idea of using seedlings with a tap-root long enough to reach soil below the layer monopolised by the roots and rhizomes of the grasses. The results of several trials during the past three years gives hopes of success with taproots from 4 to 6 feet long. But to obtain seedlings with taproots of such great length, which can be preserved uninjured during lifting and transporting to the forest, the transplants must evidently be raised in special pots or receptacles; it is possible that raising in pots may, for one reason or another, be found necessary in a few other cases besides that of sissoo in Oudh. The foregoing remarks, however, do not in any way vitiate or modify the general observations made in the preceding paragraphs.

With regard to the second point, locality, it may be generally

laid down that it should not be one exposed to early frosts or to drought, nor ought it to be so damp as to favour the development of mildew and other fungoid growth. Moreover it must not be confined in the midst of a lofty mass of forest. It should be just sufficiently inclined to allow water to drain off easily, without, on the other hand, letting it out too fast. In hilly country, however, steep ground cannot of course always be avoided, but even with a high gradient soil that holds water sufficiently well can invariably be found. Lastly, it is a great convenience to have a surface spring or streamlet near at hand from which to irrigate the nursery, especially if it runs above the latter and can be diverted into it. The vicinity of a tank above the level of the nursery is still more to be desired. In the absence of such a spring or streamlet, a well or wells must be sunk, in which case the water-holding stratum ought to be as near the surface as possible. Occasionally flat expanses of good soil high enough to be beyond the reach of damp frosts can be found along the banks of small rivers, which run all the year round or contain perennial pools, thus saving the expense of well-sinking.

No trees should be allowed to stand in the nursery, nor any so near its boundary as to interfere by means of their roots with the cultivation of the ground inside. A belt of trees along the boundary, producing useful seed and sheltering the nursery against cold or scorching winds, is always desirable.

The accessibility of a nursery is a matter of the first importance. In the plains always, and in the hills whenever possible, carts ought to be able to come up to the nursery. And for the forest or forests which it has to serve, the nursery should occupy the most central position available.

§§ 2. *Area of Nursery.*

The area of a permanent nursery ought, generally speaking, to be at least large enough to occupy fully the time of any special establishment entertained for it. It will of course vary with the area of the forest or forests which it has to serve, with the extent to which artificial methods of stocking or regeneration are resorted to, and with the average age and size of the transplants to be raised. It must be borne in mind that the labour and cost of establishing and maintaining a single large nursery is much less than that required for a number of small nurseries aggregating the same area, except that in the former case the transplants have to be carried out over a longer distance. Nevertheless, unless the distance of lead is very great, the extra cost of carriage per individual plant is insignificant, and in nearly every case it is expedient to have a large nursery. It may, therefore, be laid down as a general rule that the area of a permanent nursery should not be less than 4 acres, and in the majority of instances it should be at least 6 acres.

§§ 3. *The Form of its Boundary.*

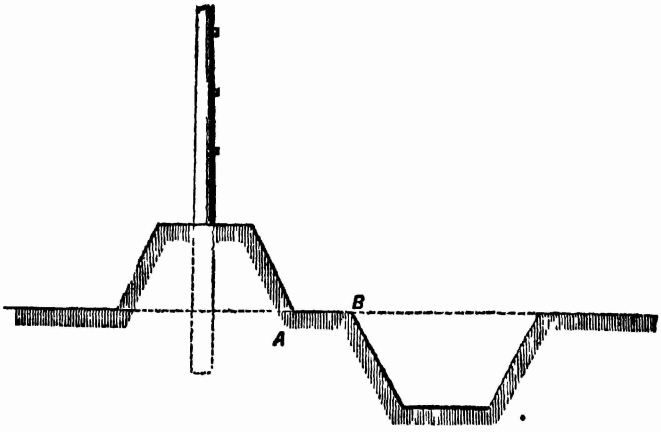
On the outer form of the nursery depends the length of its boundary, and hence the cost of fencing it. It should, whenever possible, be a regular figure. The circle would be the best form to adopt, since for the same length of periphery, it encloses the largest area of any other; and after the circle the equal-sided polygon. But neither of these figures are of any practical value, since the arrangement of the irrigation channels, and hence of the beds and paths, must always be rectangular, and would consequently lead to a great waste of space at the circumference. Hence the best figure would be the square. In many cases, however, as in the hills, the choice of site is limited, and there is no alternative but to adopt rectangles and even irregular figures. Exceptionally indeed there are even occasions in which irregular figures are advantageous, as where a portion of the boundary coincides with the bank of a river which forms a natural fence.

§§ 4. *Fencing.*

No nursery can fully serve its purpose unless it is completely protected against the inroads of cattle, elephants, pigs, porcupines, hares, deer, bears, and other destructive animals.

Where flat stones are procurable, in the vicinity and in abundance, as in most districts of sandstone and gneissose formation, a wall of dry masonry, effective in every way, can be put up at a trifling cost. A pucca wall would of course be the best, but the expenditure required for its construction would, in most cases be prohibitive. The next best kind of fence would be one of wire stretched on standards of iron or wood or better still on single slabs of stone. Such a wire fence has, however, this disadvantage that it does not stop the ingress of small animals, such as hares, porcupines and even young pigs. But if funds are available, that defect is easily remedied by means of wire netting, or, in the contrary case, by putting up against the wire fence a thorn fence formed of branches of *Zizyphus*, khair, or any other spiny bushes abundant in the vicinity, similar to those erected every year round fields in most parts of India. The branches should be inserted a few inches in the ground by their lower extremity and secured to the wires with slips of fibrous bark or with withes, the whole work being executed without any extra expenditure by the nursery establishment during their many leisure half-hours. The wire fence just described would with most advantage be erected on a mound formed by excavating an open ditch about 18 inches deep and 2 feet wide along the boundary and throwing up the earth along its inside edge. The sections of both the mound and ditch should be an equal-sided trapezium as shown in the annexed diagram, and would

necessarily be equal in area. A *berm* or *scarcement*, AB, should



be left between the mound and ditch to prevent the earth slipping from the mound into the latter. The mound should be thoroughly well beaten down before the fence is put up. The advantage of the combined mound and ditch is that they reduce the height of the wire fence required, while the ditch, besides serving as an additional protection, also performs the office of a drain. When the nursery is situated on a pronounced slope, the ditch and mound cannot obviously be employed, since they would only facilitate the erosion of the soil. On such slopes no special protection will be required along the lowest edge of the nursery, since the retaining wall of the lowest terrace (see §§ 6) would be as good as a sunk fence.

All tight-bound fences of wooden posts and wattling are entirely out of place in this country, where white ants and destructive weather influences would necessitate their constant renewal. Moreover they would be no barrier to pigs, porcupines and hares.

Live hedges of species varying with the forest region may be employed when the area of a nursery is very large, which would be the case if the nursery were used also as an experimental forest garden. But, in any case, more effective internal fences would be required for the portion of the area devoted to real nursery work. Live fences have for the most part this prohibitive disadvantage that they harbour noxious vermin, besides, when not thorny, giving free access to hares, &c. The principal species best adapted for live fences are—in the Himalayas, *Cratægus*, *Pyrus variolosa*, roses; in the plains, species of *Euphorbia*, *Zizyphus*, *Carissa*, *Cæsalpinia*, and *Acacia*, the prickly pear and American aloe, bamboos, *Capparis horrida*, &c.

Elephants can be kept out only by means of *chevaux de frise* supplemented with sharp-pointed stakes driven into the ground along the outside.

§§ 5. *Watering.*

In the climate of India, which admits everywhere of a more or less prolonged Dry Season, watering in some form or other cannot be dispensed with. Even in the few exceptional cases in which the intervals between sufficient falls of rain are not long enough to kill the young nursery plants outright, these, especially those in the seed-beds, are thrown back in their growth, unless watered artificially. And in any case it is always an indispensable advantage to be able to control the growth of the young plants without being entirely dependent on the contingency of rain falling.

Admitting then the necessity of artificial watering, we may generally lay down the rule that for nursery purposes the usually soft tepid water of a flowing stream is better than the generally hard chill water of a spring. Obviously tank water is even better adapted for the nursery than that of a flowing stream.

The chill of cold water is easily corrected by storing it in a reservoir previous to use. This storing also affords an opportunity of mixing special soluble manures with the water, which expedient, as will be seen further on, is often useful and even necessary. The reservoir, to minimise waste by absorption in the soil, by evaporation, &c. should be situated in the immediate vicinity of the nursery.

Water may be given to the plants either (A) by pouring it from above, *i.e.* by HAND-WATERING, or (B) by IRRIGATION.

(A). In hand-watering the supply of water may be brought either in skins or be led in channels from wells or tanks or running streams into reservoirs, either of pucca masonry or with merely puddled sides and bottoms sunk in the midst of the beds or lines to be watered. Hand-watering is under all circumstances both costly and slow, and when once begun has to be continued nearly every day until the first fall of rain thoroughly soaks and loosens the soil. When it is effected with watering-pots or ordinary garden pumps, a hard crust, impermeable to air and dew, forms on the surface of the soil, which crust has to be broken up by light hoeing as often as the watering takes place. This objection is obviated by the use of the garden syringe, which consists of a forcing pump whose spout is furnished with a fine rose; through this rose the water is ejected with great force in minute drops like rain, which wash off the dust, &c. clogging the green parts of the plants. Whether pots or pumps or syringes are used, the water ought to penetrate as far as the roots to produce any useful effect.

Hand-watering in permanent nurseries has its *raison d'être* only in the hills where drought is neither prolonged nor severe, and even then only in the absence (exceptional it must be said) of running streams or surface springs immediately above the nursery site.

(B). In all other cases irrigation should be resorted to: it is much cheaper, much more effective and much more expeditious. The ordinary system with the European nurseryman is to lead the water, from whatever source it is obtained, into horizontal channels running between the beds and lines parallel to their longest dimension, and retaining it therein by damming up every outlet until the soil of the beds or lines, as the case may be, is thoroughly drenched, without the water ever flowing into them. By this last precaution the formation of a superficial crust of mud is avoided. For convenience sake I will term this the SIDE-DRENCHING system.

A common method employed by native gardeners and agriculturists is to enclose the beds and lines by a continuous ridge of earth 5 or 6 inches high and to flood them with 3 or 4 inches of water. By this means the soil is perhaps more effectively drenched, as more water can be thus given in a single operation, and, moreover, there is no loss of time as in the side-drenching system, in which the nurseryman has generally to wait until one line of beds has absorbed moisture completely before he can proceed to water the next row of beds; but, on the other hand, the formation of a superficial crust of mud, which must afterwards be raked and broken up, is inevitable. The water let into the beds sometimes stands as much as one hour before it is completely absorbed by the soil. The method just described may be termed the FLOODING system.

Whether the side-drenching or flooding system be employed, the effect is the same as regards the total destruction or banishment of white ants, rats, mice, and most other burrowing animals, the depredations of which seem only to be aggravated by hand-watering.

Another advantage which irrigation possesses over hand-watering is that it succeeds in shallow soils where the latter fails.

Although implied under the head of site, it may be stated here that the spring or tank, from which the water-supply is obtained, should not be so near the nursery as to keep the soil constantly in a thoroughly saturated state, which would not only directly injure the growth of most species, but also produce severe damp frosts.

When a tank, spring, or stream is on a lower level than the nursery, the water has obviously to be lifted. Of the various water-lifts in use in India the best are the Persian Wheel (of which there are several forms), the Double *Mot*, *Charas* or *Charsa*, the *Dheki*, *Dhenkli* or *Dhenguli* and the *Lathi Kundi*, which will all be found described with sufficient detail in the Appendix. The water thus lifted can be led away at once into the nursery beds and lines, or stored up in a reservoir until wanted. When the distance of lead is considerable, say exceeds 50 yards, iron pipes, or cheaper still, gutters of wood or sheet

iron, supported on wooden or iron trestles, are easily and economically set up. Masonry channels, if on a large scale, are extremely costly, and earth embankments, however well puddled, are very wasteful, and require constant looking after.

In the absence of all other sources of water-supply, the only plan is to sink wells, the number and size of which will depend on the area of the nursery and the abundance of water in the stratum in which they are sunk. The most effective water-lifts to employ in this case would be the Persian Wheel and Double Mot.

The best time for watering is, according to the experience of Indian gardeners and agriculturists, the afternoon.

The explanation of this, as far as the hot weather is concerned, is obvious, for watering early in the day would result in a very large proportion of the water being lost by simple evaporation. But as regards the cold weather, in places exposed to night frosts, it is evident that the later a plant is watered, the larger will be the quantity of moisture contained in its tissues, and hence the slighter its resistance to frost during the night. And not only this, but the increased humidity of the air in which the plant is bathed is bound to aggravate the severity of the frost. Hence the proper plan in the cold weather would be to perform the watering in the forenoon; and if from wells, since well water is always much warmer than the air and the soil in the morning during that period of the year, as early in the day as possible. But, whenever practicable, watering ought to be entirely dispensed with in frosty situations during the Cold Weather.

When there is advantage in watering in the afternoon, the whole or portion of the water-supply that is available in the forenoon can, if necessary, be stored up in reservoirs. Such storing is unavoidable when the discharge of the canal or natural stream, on which the nursery is dependent, is insufficient to irrigate the required area within a given time.

§§ 6. *Preparation of the soil.*

The first thing of all to do is to clear the ground of every tree and shrub, and to grub out the stumps and principal roots. The best implements to use for this purpose and the most expeditious and economical method of effecting it need not be described in a work on Sylviculture, since the art of felling trees and extracting stumps and large roots belongs to another branch of Forestry, under which it will most appropriately be treated.

Next, the ground must be levelled. In the plains, if the surface of the soil is more or less even and has only a slight slope, and provided the length of the nursery in the direction of the slope is not great enough for there to be any very appreciable difference of level between its lowest and highest

portions, this end is accomplished simply by means of the ploughing operations followed by a few sufficiently heavy falls of rain. The deeper depressions must, however, be filled up with good topsoil brought from outside the nursery.

If, all other circumstances being the same, the difference of level is marked, exceeds say 4 or 5 inches, the site of the nursery must be divided off into horizontal terraces, the edges of the terraces being protected against slipping or erosion by means of retaining walls of dry masonry. Pucca walls, being necessarily built on solid foundations, would be excessively costly, and also have the drawback of impeding a free drainage.

The labour of terracing will obviously be directly proportional to the tangent of the angle of slope, and the width of the terraces will equally obviously vary jointly with the angle of slope, and the depth and richness of the topsoil. Moreover, in forming the terraces the height of each terrace ought to be so chosen that the cutting shall, as far as practicable, be equal to the quantity of embankment, in order thereby to minimise both the labour of cutting and the distance of lead for the earth cut, and to utilise every bit of this latter.

The use of a levelling instrument is always indispensable, as the best work with the eye cannot but fail at many points, and cause hereafter much annoyance and heavy expenditure on frequent repairs of broken terraces and eroded soil.

Under any circumstances, we cannot, in India, get rid of the necessity of protecting the soil against erosion, since every year heavy falls of rain occur, a large proportion of which, not being able to enter the soil as fast as it falls, rushes off the surface, cutting channels through it, and carrying away a considerable portion of the top-soil, especially if this has been loosened by cultivation.

Whatever the character of the ground, the following rule should be universally observed:—The rain falling on higher land outside the nursery should in no case be allowed to run down into the nursery, nor ought any portion of the rainfall within the limits of the nursery to be permitted to be carried off outside by *surface* drainage.

In the plains, the mound system of fencing, already described on page 425, answers perfectly as a protective work. The mound prevents a rush of water both into and out of the nursery; while the ditch serves not only to drain off with sufficient rapidity any excess of moisture in the soil of the nursery itself, but carries off all the surface drainage of the higher ground outside. Indeed, when the fall of the ground does not exceed about 1 in 200, the mound alone is so effective that it is common to see large fields as it were walled off by mounds of mere earth into a number of very nearly level compartments. Any slight difference of level that exists is soon

corrected by rain, and the compartments form a succession of low terraces with earthen parapets.

In the hills, besides supporting the terraces by a retaining wall, as already described, a violent rush of water over the edges, and the consequent washing off of the soil, is prevented by sloping the terraces slightly inwards. The rain falling on the slopes above, if they comprise an area large enough to receive an appreciable fall during a single shower, can be easily diverted by means of one or more channels into the nearest ravine or gully.

The next point to attend to, after clearing and levelling the ground and protecting the soil against erosion, is the freeing it of all its larger coarse elements down to 18 inches at least below the surface. The object of this operation is to have the soil contain nothing that would blunt the sharp implements of the nurseryman, and also to give it a uniform texture.

First of all, the stones lying on the surface ought to be picked off; those below the surface are got rid off during the progress of the actual tillage. Where the stony element is at all abundant, some of it will still remain, and will have to be removed by sifting when the nursery beds and lines are prepared, as explained further on.

Lastly, we have to consider the tillage or real preparation of the soil, the object of which is to kill out the roots of all existing growth and to loosen and, if necessary, to correct the defects of the layer of the soil that is to contain and nourish the roots of the plants to be raised. In thus breaking up the soil, care must be taken to bring up to the surface as little as possible of its under layers, which have never been exposed to fertilising weather influences.

If the operations preceding the tillage have not already removed the low vegetation that covers the ground, this should now be got rid off. Amongst native gardeners and agriculturists it is usual to burn off this low vegetation. This plan is to be deprecated (except on acid or stiff clayey soils, which should in the first instance never be chosen), as its only recommendation is a very petty economy; it not only destroys the organic matter in the top layer of the soil, but also bakes the latter. There is no alternative but to use the grubbing axe, scythe or sickle, and to carry away out of the nursery area or to the manure pit all the rubbish cut. Nevertheless, if the quantity of this is not considerable, it may be collected into small heaps up to a foot high scattered all over the area, and fired on a calm, dry day so as to ensure complete combustion. The succeeding tillage operations will suffice to mix the ashes thoroughly with the soil. Half-burnt remains of the rubbish are always strongly acid, and, if introduced into the soil, their decomposition during the first ensuing rains will, by reason of the heat thereby developed, also affect injuriously growing vegetation on it.

The deeper the soil is turned up, the better; and hence, theoretically speaking, the pick or hoe is the best implement for the purpose. But the progress of work with those implements is very slow, and, except on narrow terraces on steep hillsides where no other implement could be used, they must always yield the place to the plough. Whatever the pattern of the plough employed—and this varies greatly in different parts of India—the share must enter the soil deep enough to tear up completely once for all the vivacious roots and underground stems of existing vegetation. If any of these are allowed to remain in the ground, they will soon multiply and render the nursery work impossible. The creeping roots of woody species that throw up suckers cannot, however, always be got rid of with the plough, as they often (*e.g. Phyllanthus Emblica, Boswellia thurifera, Ougeinia dalbergioides, Diospyros Melanoxylon,* &c.) go down to a depth of 2½ feet and more, and hence the only way to deal with them is to dig them out one by one with a pick or hoe wherever a sucker or stump shows itself.

Deep cultivation is justifiable for the following four reasons:—(i) It is the only way to kill out all existing growth and to clear the soil of all roots and underground stems. (ii) The layer of soil, in which the roots of the seedlings to be raised are to spread and be nourished, can never be sufficiently loosened. (iii) This loosening of the soil is absolutely necessary in order to admit air, with its carbonic acid and nitrogen compounds, into the lower layers and thus fertilise them. (iv) While it prevents a sudden excess of damp in the layer of the soil occupied by the nursery plants and preserves them from what has technically been called *wet feet*, it also helps to preserve moisture in it during drought and to encourage the formation of dew in its innermost layers during the Cold Weather.

The best time of the year to begin ploughing is the Cold Weather: the soil is then still soft and yielding, and the sun is quite strong enough, or the cold great enough, to destroy the vitality of the roots and underground stems turned up. One or two women or boys should follow the plough and pick or pluck out all stones and roots brought up to the surface. If the land has had woody growth on it, the ploughman should be armed with a light axe with which to cut through all roots sufficiently strong to arrest the progress of his plough. A coulter fixed to the shaft of the plough, and strong enough to cut through woody roots 1¼ inch thick, will facilitate and expedite the ploughing work very considerably.

This first ploughing should be repeated at least twice, each time in a direction at right angles to the preceding one.

Fragments of roots and underground stems will, however, still remain in the soil, and the next operation will be to work it successively in two directions at right angles to one another

with the bullock-hoe, the size of which will be proportionate to the depth to which the plough has penetrated. This hoeing will break up the larger clods and bring up to the surface nearly all the roots remaining in the soil, which, together with stones, must be picked off as before, as soon as they show themselves. The clods are still further reduced by means of a log-roller or a special clod-crusher drawn by oxen. After this, it is advisable to hoe the soil over again in the same manner as on the first occasion.

The soil should then be allowed to lie thus until the first fall of rain has thoroughly soaked it, when it should be hoed over once more in the same manner as before. The result of this last hoeing will be that all the last clods, large and small, will be thoroughly broken, the soil acquire a soft, uniform texture, and the surface be evenly levelled.

The entire area of the nursery ought to be cultivated in the manner described, *i.e.*, not only the portions that are to compose the future seed-beds and lines, but also those which will constitute the roads and paths. As said before, the smallest remnants of vivacious roots and underground stems left anywhere in the nursery will soon multiply and spread, and not only cause much trouble and expense afterwards, but also impair efficiency very materially, and unfit a considerable portion of the area for the purpose for which it is required.

If the soil is poor in bases, as when it is a stiff clay or a nearly pure silicious sand, it is advisable to strew quicklime or, which is generally more economical, finely ground *kankar* over the surface just before the last two hoeings. The quantity of lime or limestone to use will depend on the nature of the soil in each particular case. Beyond the liming no manures should be applied until after the nursery beds and lines are laid out.

It is much to be recommended to grow a previous crop or two of potatos, Indian corn, rice, *Sorghum*, sugarcane, sesamum or cotton, whichever is the most suitable, before laying out the area as a nursery. The cultivation of such crops, which require very thorough weeding, effectually clears the soil of every trace of the previous vegetation that covered it, corrects all its harsh qualities, loosens it thoroughly, renders its texture perfectly soft and even, and completes the levelling of the ground. Potatos, sugarcane, and cotton are the best crops for our purpose, as cereals and oil-seeds attract rats and mice. While improving the soil and site, these crops will, besides, yield a large money return.

§§ 7. *Laying out beds, paths, &c.*

In laying out the interior of a nursery two main points have to be kept in view: (a) how to make the best use of the given area, and (b) how to perform the watering in the most economical and effective manner.

For every permanent nursery there should be a good set of offices for the establishment and for storing implements, seeds, &c. If the area is large, these buildings should be situated at or near its most central point in order to facilitate constant supervision both by day and night. If the area is limited, they should be erected immediately outside, and this can obviously, for the very reason that the nursery is small, be done without in any way impairing efficiency. The cattle used in connection with a nursery ought invariably to be stalled outside.

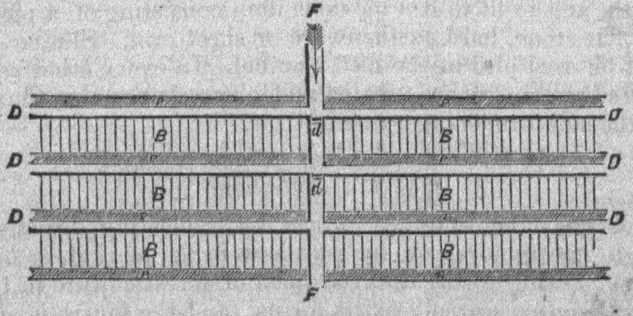
In large nurseries it is generally advantageous to have a cart road leading up at least to the nursery buildings, and, if possible, also carried further on, so as to bring it within easy reach of every part of the area. To economize space as well as money, it is expedient to give it only sufficient breadth for a single cart, but widening it at its extremity so as to enable the cart to turn. This road should be metalled and have a slightly convex section. Besides this, it ought to be raised somewhat above the level of the adjoining soil, and be protected with well-made side-drains. One corner, the shadiest and most protected of the nursery, ought to be specially set aside for preparing and storing manures.

The next step is to lay out the paths and nursery beds. These latter should be just broad enough for a boy, 9 or 10 years old, to reach the middle with his hand without having to step on them. A breadth of 40 inches is very convenient. Their length need have no limit, except what is fixed by the shape of the ground, and by the number of plants of each single species to be raised. Their shape ought always to be rectangular. The beds must be divided off from each other by paths about a foot wide, which will thus consist of two sets crossing one another at right angles. One of these sets of paths ought to abut perpendicularly on the cart road, when there is one.

When the nursery is to be irrigated, the paths running parallel to the longest dimension of the beds should follow horizontal lines, and the water should be led from the source whence it is obtained into a primary or FEED channel or channels, as the case may be, of sufficient width and depth, and cut between two groups of beds at right angles to that direction. Smaller DISTRIBUTING channels at right angles to, and on each side of, the feed one, and about six inches wide and four inches deep, should be hollowed out between each bed and the path adjoining it on the side from which the water comes down the latter. In Europe the paths themselves serve as such secondary channels; but in India, where large quantities of rain fall within a limited time, the paths, if used as watercourses, would be rendered quite unfit for circulation, and any attempt at circulation would, in turn, render the paths unfit as channels for distributing water. It is then evident that in this country it will always be expedient to beat the paths firm

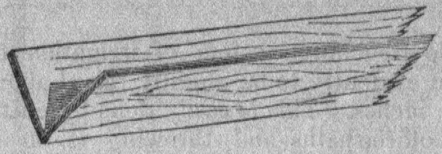
and to gravel them. The end of the distributing channels not connected with the feed one must be kept permanently closed.

In the side-drenching system of irrigation the surface of the beds ought evidently to be slightly raised above the paths, say about 2 inches. This is easily done by cutting a portion of the top soil off the paths and throwing it on to the beds. The adjoining distributing channels act as side-drains during a shower of rain, and protect the paths from being washed away. The water for irrigation is retained in the distributing channels, until the adjoining bed or beds are thoroughly soaked, by means of small removable dams consisting of a single piece of wood, earthenware, sheet iron, or stone fixed across the feed channel in a continuous line with the lower edge of the distributing ones, and just a fraction of an inch below the level of the paths, so that before the water could rise up to the top of the beds, it would flow over the dams down the feed channels. On even open ground the disposition of the beds, paths, and channels would be as represented in the adjoining diagram, in which B B are the beds, P P the paths, D D the distributing channels, F the feed channel, and d d the dams.



When the dimension of the nursery in the direction of the length of the beds is too great for a single system of feed channel with its distributors to perform the irrigation conveniently and efficiently, there must be more than one such system laid out; and, when this is the case, the feed channels should themselves be fed from a main one running at right angles to them at the highest end of the nursery. On hill sides the feed channels on each terrace must receive their water directly from those immediately above them; and hence, to prevent erosion, it is necessary to pave them, if not along their whole length, at least at both their extremities. In the hills flat stones adapted for this purpose are, as a rule, easily obtainable, and both the sides and bottoms of these channels can be protected with such stones at a trifling cost. But a simpler

expedient is to form the channel with two planks joined edgewise as shown in the accompanying figure.



At the upper end of the feed channel on each terrace, a wooden cask may be let into the ground to receive the water coming down from above, and hold a sufficient quantity for various purposes, the necessity of which may arise at any moment.

If the flooding system of irrigation is employed, it is evident that the beds must be lower than the paths, and, indeed, on the same level as the distributing channels. The water is usually admitted into the beds by removing with the hand three or four inches length of the ridge flanking the distributing channel and restoring it as soon as the beds are sufficiently flooded, removing at the same time a temporary dam of wet clay placed across the feed channel to turn the water into the distributors. It would be a great improvement, and one that is easily made, to maintain a permanent opening in the ridge of earth, and to fit to it a movable dam consisting of a piece of wood, flat stone, hard earthenware or sheet iron. Similar dams should be used also in the feed channel. In every other respect the arrangement of beds, paths and channels remains the same as in the side-drenching system.

§§ 8. *Collection and storage of Seed.*

§§§ 1. *Collection.*

Seeds may be obtained either by collecting directly, or through contractors, or by purchase in the market, or by exchange. Owing to the backwardness of forest culture in India, the third source scarcely exists for us, and the fourth is almost as limited. This is, however, no great disadvantage, as seeds collected directly or through contractors must necessarily belong to the latest crop, and are more likely to be fertile and sounder than those obtained otherwise; and not only this, but they can be more thoroughly tested.

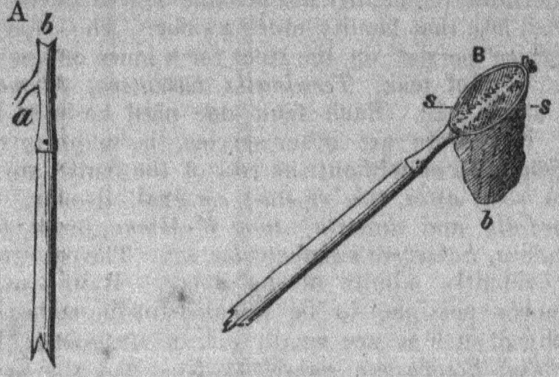
The best seeds are produced by fully fertile, healthy, vigorous trees growing not too close together in a favorable soil and situation. Very young trees usually furnish a large proportion of barren seed, while very old or weakly trees yield seeds which are not only difficult to keep but also produce weak plants. Deformities in trees are often inherited, as for instance twisted fibre, a squat habit, &c. Twisted fibre can be easily detected in trees possessing a cracked bark or rhytidome, as the cracks follow the twist.

Seeds ought to be collected only when they are completely ripe: such as are not fully ripe when taken off the tree do not possess the germinative faculty in the same degree as ripe seeds and, moreover, lose that faculty much sooner. The ripe fruit of some species persist on the trees for a more or less considerable time; *e.g.*, of teak, *Terminalia tomentosa*, *Pterocarpus Marsupium*, sissoo, &c. Such fruit one need be in no hurry to harvest. But there are other species, the majority of the seeds of which, with or without the rest of the fruit, are shed as soon as, or soon after, this ripens; *e.g.*, sal, deodar, *Quercus semecarpifolia* and *dilatata*, *Abies Webbiana*, birch, *Lagerstræmia parviflora*, *Schrebera swietenioides*, &c. The collection of such seeds evidently admits of no delay. Rainy weather ought, whenever possible, to be avoided for the collection of seed, especially of such as are small, *viz.* of *Anogeissus*, birch, *Adina cordifolia*, *Stephegyne parvifolia*, &c.; but this prohibition obviously does not extend to such seeds as are to be sown at once, or, which comes to the same thing, as cannot under any circumstances be preserved, *e.g.* sal, *Quercus semecarpifolia*, &c.

According to the various species, seeds must be collected in different ways. The fruit may (i) be hand-plucked off standing trees, or (ii) off felled trees, or (iii) be gathered off the ground after they have fallen naturally, or lastly (iv) be broken off with a hook from standing trees.

(i). HAND-PLUCKING OFF STANDING TREES.—This method is the most costly of the four, but is the only one applicable in the case of small or light fruit, *e.g.*, *Pterocarpus Marsupium*, *Ougeinia dalbergioides*, *Anogeissus*, khair, sissoo, *Hardwickia*, elms, maples, ash, &c., or of small light seeds that escape from the ripe fruit still hanging on the tree, *e.g.* deodar, silver fir, birch, *Schrebera swietenioides*, *Andromeda*, &c. The seed collector must climb up into the crown of the tree, with or without the help of a ladder, just as he can manage, and with a sack slung over his shoulder. What he cannot reach directly with his hand, he must draw to within arm's length of himself by means of a hook attached to the end of a light but strong sapling or bamboo of sufficient length. Branches and branchlets break off less easily when drawn upwards than if pulled downwards; hence it is always advisable for the collector to climb up to the highest point he can attain and begin by plucking off the fruit hanging at the summit of the tree. The fruit of many species is more or less articulated to the twig which bears them, and is thus easily gathered; but that of some species can only be plucked by twisting or otherwise forcibly breaking off the twig. For the latter class of fruit the use of a cutting implement, such as a pruning knife is to be recommended. Figure A represents a convenient implement,

which combines a hook (a) and a cutting edge forming a re-entering angle (b). Figure B is a rough sketch of the imple-



ment commonly used by mango gatherers, and slightly improved to suit the forester's purpose. The bag (b) receives the fruit or seeds, and prevents them from escaping or falling to the ground; *s s* are fine sharp saw edges. The common Indian sickle may also frequently be employed.

(ii). HAND PLUCKING OFF FELLED TREES.—Trees that are to be cut for export in the ordinary course of work often yield a considerable supply of good seed. They should be felled immediately the fruit is ripe. A pruning hook often facilitates very materially the collection of the fruit. This is the only method applicable to the various kinds of bamboos.

(iii). GATHERING OFF THE GROUND.—The seeds that fall first are generally barren or worm-eaten; they should invariably be rejected. To this end the dead leaves and early fallen fruit or seed should be swept away from under the selected trees. This method of collection is very economical, and is peculiarly suited to large heavy fruit which falls more or less perpendicularly and which does not break up and allow the included seed or seeds to disperse, *e.g. Quercus incana*, the sandalwood tree, &c., sal, *Terminalia Chebula* and *belerica*, &c. To help the fall of the seed or fruit, the branches of the trees may be shaken.

(iv). BREAKING OFF THE FRUIT FORCIBLY FROM STANDING TREES.—When trees marked to fall within a year or so are chosen as the seed-bearers, it may be found inconvenient or impossible to fell the trees as soon as the fruit ripens. On account of the nature and small size of the fruit and seed, the Third Method may also be inapplicable, while the First would be unnecessarily expensive, since there is no reason for sparing the fruit-bearing branchlets and twigs of such trees. The fruit may then be broken off singly or in bunches with the aid of a strong hook forming a sharp angle of about 30° firmly attached to one end of a long sapling or bamboo. The inside

edge of the hook should be sharp and serrated and slightly curved inwards. The hook should be passed over the fruit-bearing branchlet or twig at the point at which it is to be broken off, and jerked downwards; or, if that does not suffice, it should be twisted round once or twice, by which means the branchlet or twig, as the case may be, will be firmly caught in it and a single jerk will then suffice to cut the former through. Where small wood has no value, and there is no objection to thinning out the crowns of the trees, branchlets of a certain thickness may be cut off with a bill hook, and the fruit then hand-plucked from them. Some trees produce bunches of fruit, the common stalk of which dries up at maturity and easily disarticulates from the rest of the branchlet. The panicled fructification of teak is a good instance in point. The present method may be employed with such trees, both independently and also to supplement the Third Method, when all the fruit, although they ripen more or less simultaneously, do not fall together.

§§§ 2. *Treatment after collection.*

The fruit of many trees require to undergo some previous manipulation before the seed is in a fit condition to be sown or stored up. Either (a) the seed is enclosed in a fleshy pulp, *e.g.*, *Dillenia*, *Schleichera trijuga*, *Artocarpus*, *Gmelina arborea*, *Diospyros*, &c.; or (b) it is covered with a thick tough fibrous rind, *e.g.* cocoanut, &c.; or (c) it is included in a capsule or pod, or between scales, *e.g.* *Lagerstræmia*, *Schrebera*, *Michelia*, khair, *Hardwickia*, babul, *Coniferæ*, &c., or (d) it is surrounded or armed with foliaceous or comaceous appendages, which interfere with its uniform distribution in sowing as well as uselessly increase its bulk and weight, *e.g.* Teak, some *Terminalias*, *Pterocarpus Marsupium*, elms, maples, pines, firs, poplars, willows, &c.; or (e) it is so full of moisture that it cannot be stored up at once without heating and fermenting, *e.g.* pines and firs, *Anogeissus*, *Quercus incana*, &c.; or (f), although as ripe as it can ever become on the parent trees, it would germinate badly or after much delay if sown as soon as collected, *e.g.*, teak, *Terminalia tomentosa* and *Arjuna*, *Pterocarpus Marsupium*, babul, ash, &c.

(a). SEEDS ENCLOSED IN A FLESHY PULP.—In many cases the pulp may be got rid of by allowing it to rot in heaps, and then washing it off in large vats with abundance of water, working the contents of the vats well with strong rods bound together broom-fashion. Edible fruit, such as that of *Zizyphus*, *Diospyros*, *Buchanania*, *Schleichera*, &c., give no trouble; people who live in or close to the forest will bring in all the seed required in return merely for the privilege of collecting the fruit, with occasionally a trifling money renumeration added. Some kinds of fruit may also be given to goats and cattle, which eject the seed when chewing the cud, *e.g.* *Zizyphus*, *Terminalia belerica*

and *Chebula*, *Phyllanthus Emblica*, *Gmelina arborea*, *Prosopis spicigera*, &c.

(b). SEEDS COVERED WITH A THICK FIBROUS RIND.—The rind must be torn off with the aid of force and special shears.

(c). SEEDS INCLUDED IN A CAPSULE OR POD, OR BETWEEN SCALES.—The quickest method, when that is practicable, is the application of heat, under the action of which the valves of the capsules or pods and the scales of the cones open out or disarticulate, and allow the enclosed seeds to escape out. In many cases simple exposure to the sun suffices; in others, however, a higher and more sustained temperature is required, and then special drying houses are necessary, in which the fruit to be treated is exposed to the direct action of air heated by steam pipes or over an open fire, and kept at the required temperature with the aid of thermometers. The coverings and scales are separated from the seed by raking or riddling or winnowing, according to circumstances. But the application of heat does not suffice for, or even does not succeed at all, with the fruit of many species, *e.g.* sissoo, *Hardwickia*, babul, khair, &c. In this case, if the seed is tough enough, threshing in sacs or in the open air, or treading with bullocks on a well-beaten level floor in the manner of the Indian agriculturist gives good results. Some of these seeds, however, chiefly of leguminous plants, do not stand such rough treatment, *viz.*, *Hardwickia binata*, sissoo, &c., and the only way to free them, as far as I know, is to manipulate each fruit individually with the hand, in case the separation of the seed from its covering is deemed necessary.

(d). SEEDS WITH FOLIACEOUS OR COMACEOUS APPENDAGES.—The wholesale removal of these appendages, except one by one with the hand, is not always possible without injury to the germinative power of the seeds; but whenever practicable, it should be effected. If the seed is hard or tough, friction, more or less rough, suffices to detach these appendages. When this is the case, a very expeditious method is to nearly, but not quite, fill large stout sacs with the seed, and to thresh these or work them violently backwards and forwards, according to the toughness of the seed, until the appendages are detached or crushed, when they can be easily separated by the ordinary process of winnowing. Treading with cattle may sometimes be found efficacious. Threshing is necessary for seeds of *Terminalia tomentosa* and *Arjuna*, *Pterocarpus Marsupium*, &c. Treading with cattle or friction in sacs will succeed perfectly with teak, &c. With brittle or otherwise delicate seeds the following process may often be employed with the best result:—They should be spread out and sprinkled over lightly with water from a pot with a fine rose, and moistened thus, they should be collected into large heaps. As soon as a gentle heat is felt on inserting the hand into these heaps, they ought to be

spread out to dry. When the seeds are again dry, the appendages will be found to have disarticulated of themselves.

(e). SEEDS TOO MOIST TO BE STORED UP AT ONCE.—The seeds of many species have to be plucked from the parent tree before they are quite dry, in order to prevent their being disseminated and scattered far and wide. Other kinds of seed contain a great deal of moisture even when they fall off naturally. Such seeds should be spread out not more than from 2 to 3 inches high in a dry, airy, sunny place, and turned over with a rake twice or thrice daily for a period varying with the kind of seed and the dryness and temperature of the weather. After this they should be piled up higher, the raking being continued as before but being limited to only once a day. This latter process should go on until the seeds are sufficiently dry. Experience alone can tell when this is the case. It is needless to say that in the cold weather the seeds should be removed under shelter while dew is being deposited. As regards seeds that are moist even when they are shed naturally, this drying is really the completion of the ripening process, for such seeds germinate more promptly when they have been thus dried than if sown as soon as they fall off from the parent tree.

(f.) SEEDS THAT REQUIRE A FURTHER PROCESS OF RIPENING AFTER FALLING OFF FROM THE PARENT TREE.—Among agricultural crops our gram is a well-known instance of such seeds: it will germinate freely only several months after it has been harvested. Instances of forest seeds, already given higher up, are those of teak in Central India and Bombay, of *Terminalia tomentosa* and *Arjuna*, of *Pterocarpus Marsupium*, babul, ash, &c. Drying increases the germinative faculty of each one of these species, especially the power of swelling up of the embryo and of the perisperm (when there is one) by the imbibition of water. In the case of teak in Central India, it would appear that continued exposure to all the alternations of the weather during a whole year, provided fermentation is prevented, favours the second ripening process.

(To be continued.)

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